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Motor Drive as Viewed by Machine Builders and Motor Manufacturers

BY C. E. CLEWELL

The viewpoints of manufacturers of motors, machine-tool builders and plants who have used the combined product in the form of motor-driven machine tools are given in this article. As motor manufacturers look favorably upon motor-driven machinery greater stress is placed upon the attitude of machine--tool builders to the problem than upon motor manufacturers. Some practical aspects of the electric-power situation based on some actual opinions from various machine-shop industries are included.

ARTICLES containing more or less conflicting statements in regard to the advantages and disadvantages of the electric motor for machine-tool driving have appeared in the technical press from time to time during the past few years. It is believed, however, that a better grasp of the situation can be gained by a study of the present attitude of machine-tool builders toward motor-equipped machine tools than from articles based on a single viewpoint, since this attitude reflects to some extent at least the demand for such a method of drive by the manufacturers who purchase machine-tool equipment.

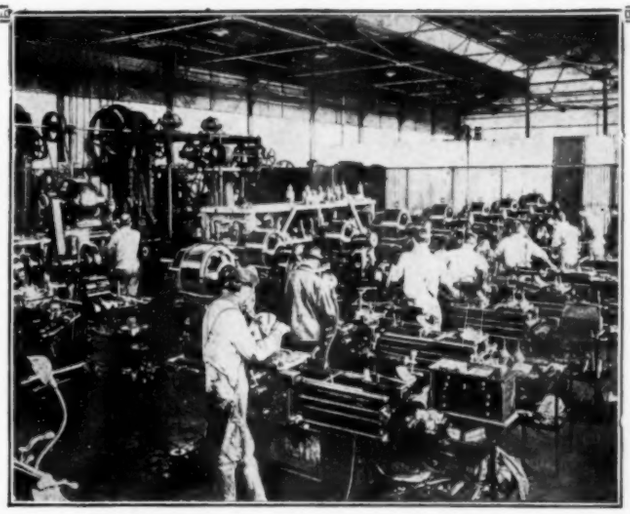


FIG. 1. INDIVIDUAL-MOTOR-DRIVEN MACHINE TOOLS

For the purpose of obtaining views of this kind I gathered opinions from representative machine-tool builders in 1914 and again during the past months, so that this article is based on actual opinions from various industries in this field. The opinions gathered in 1914 were at the instance of the *American Machinist;* those gathered recently were for the *Electrical World* and were used to illustrate a modern viewpoint of motor applications. This article coördinates the older and more recent opinions, giving an indication of the changing attitude in favor of the motor after an interval of three to four years.

THREE VIEWPOINTS

The question of the motor and its usefulness to the shop is one that must always rest upon actual rather than imagined advantages, and the answer to the question of which method of drive is best depends on the judgment of those plants where motor-driven machinery is subject to the test of everyday service.

It is perhaps apparent to the reader that the manufacturers who build motors naturally view the situation in a way favorable to their own commercial interests, but it is only fair to add that probably more high-grade engineering investigations and attention to the accumulation of exact data on the real advantages of the motor under shop conditions have been due to the motor manufacturers than to any other branch of the industrial field. Another viewpoint is that of the users of machine tools. The user of such equipment is naturally and logically the very one to decide finally which of the various methods of drive is best suited to shop conditions and the most economical from all standpoints. It is probably safe to assume that the demand for an adjustable-speed motor with a wide range of speeds and close gradations in speed adjustment was dictated largely by the needs originally felt for such driving mechanism by users of machine tools after the appearance of high-speed tool steel. The policy of the motor manufacturers has been to observe and search out just such needs in the shop field and then to design motors that can supply those needs.

Still another viewpoint is that of the machine-tool builders. They stand in a certain sense between the motor manufacturers and the user of machine tools, and in this light their opinion, so far as it indicates the tendencies of supply and demand, may be taken as a valuable basis for a general decision as to how motor-driven machinery is meeting the needs of users of their product.

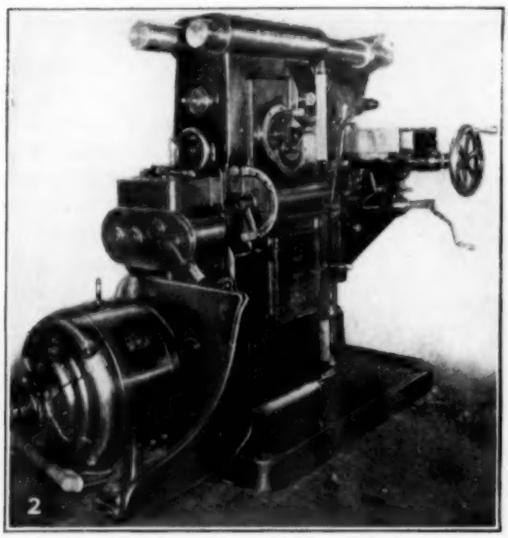
OLDER AND MORE RECENT OPINIONS COMPARED

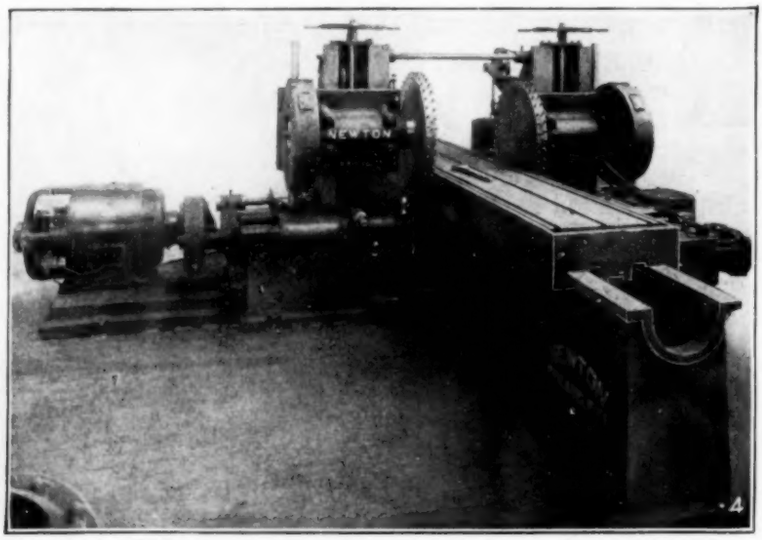
The general impression given by a comparison of opinions gathered in 1914 with those collected more recently is that a change has taken place within the past three or four years in the attitude of machine-tool builders toward the use of the motor. In the earlier canvass there appeared to be some hesitation in admitting the superiority of the motor-driven machine tool. More recently the views of 10 of the leading

machine-tool builders indicate a practical uniformity in favor of the motor drive.

The opinions obtained in the more recent canvass of the field possess unusual value because they relate to four fundamentally important aspects of the motor-drive problem; that is to say, (a) to the general attitude of the various machine-tool plants to the question, (b) to the points in which motor drive is considered superior to other methods of drive, (c) to the approximate percentages of machine-tool output supplied for individual motor drive, for group motor drive and for straight lineshaft drive, and (d) to the more recent changes in the design of modern machine tools in order to adapt them more conveniently to the motor drive.

The following opinions of machine-tool builders toward motor-driven tools relate to the equipment of new machine tools, which is an entirely different proposition from where a shop modifies its equipment so as to change old machine tools from belt to individual motor drive:





FIGS. 2 AND 4. TWO TYPES OF MOTOR DRIVE

Fig. 2—Polyphase induction motor driving a milling machine. Fig. 4—Individual-motor-driven machine with geared connection

General Opinions

Individual-motor drive, according to a recent canvass of 10 leading machine-tool builders, is preferred on large machine tools in practically all cases and for smaller machines where feasible. In one case the individual-motor method of driving is preferred to all other methods; in another about 80 per cent. of the machine tools are individual-motor driven, this being an index of the way the question is viewed in their own shops. In one case both belt drive and motor drive have their legitimate field of operation. In the main the tone of all 10 opinions is highly favorable to the use of the motor.

Points of Advantage

Following up the general attitude of the various manufacturers with reasons why the motor is considered superior we find a number of interesting comments which may be summarized somewhat as follows: By mounting the motor on top of the machine the driving mechanism is protected from dirt and other injury and is out of the way; flexible equipment, shop lighter and cleaner and the problem of upkeep reduced; number of working parts in the transmission reduced and speeds changed readily; economy in energy, space and material. In several cases, however, emphasis is placed upon the importance of scientifically adapting the machine tool in its design to motor drive.

An example of the last-named point is advanced by one firm in which a disadvantage of motor drive is given, such as the complex mechanical attachments in direct-motor driving when the machine tool has not been adapted to it, and along this same line another firm advances the point that in all special cases as those of single-pulley drive for screw machines or turret lathes, for heavy planing machines and also for boring machines the first cost of the machines is less, but only for such tools as have been designed for either method of driving. One of the statements in this connection is that of a tool builder in which the superiority of motor drive is given in terms of such points as constancy of power input, no belt slipping, adaptability of the machine tool to overtime work, freedom from dependency on the rest of the shop, and, in some cases, greater convenience of control. The choice, according to this builder, should be governed by the circumstances under which the machines are to be operated.

Various Types of Drives in Percentages

It is difficult to derive exact figures on the output of machine-tool plants even on a basis of such data, since there is no easy way for a machine-tool plant to know whether its machines are for use on line-shaft drive or for group drive. However, the figures on individual-motor-driven tools are more readily obtained, and hence the figures to follow relate mainly to them. It should be remembered that the nature of the product of a machine-tool plant, that is, whether the machines are large or small and dependent also upon the class of machines, will govern the greater or lesser use of the motor to some extent, and allowance for this should be made.

The percentages of the output of the 10 plants

equipped for motor drive range from about 5 per cent. in one or two exceptional cases up to 95 per cent. in others. Actual examples may be cited as follows: In one case about 36 per cent. motor driven; in another very few machines furnished for belt drive; in another about 50 per cent. at least for individual-motor drive, practically all the rest for group motor drive; in another

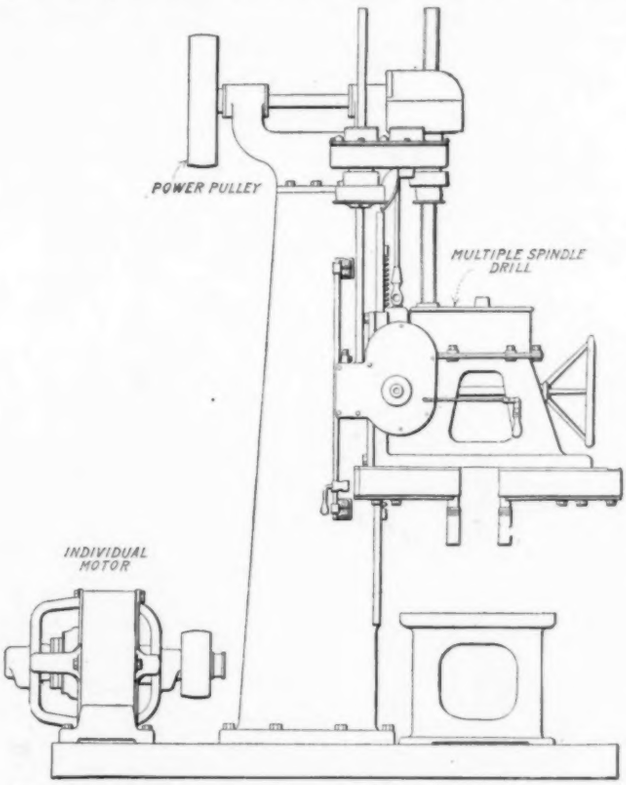


FIG. 3. DIAGRAM SHOWING ARRANGEMENT OF A MACHINE FOR INDIVIDUAL-BELTED MOTOR DRIVE

about 95 per cent. motor driven; in another about 40 per cent. of planing machines are individual-motor driven and about 85 per cent. of boring machines are for individual-motor drive.

Other figures might be added to the foregoing, but those given show increased use of the motor as an integral part of machine tools, and this use is resulting in more attention to the design of motor mounting and its adaptability to the machine tool in size and shape, power-transmission apparatus, location of control levers and items of this kind.

The foregoing points may be summarized in the form of a list of advantages of individual-motor drive based on a very complete table of such advantages as prepared and submitted to me recently by E. E. George, plant engineer of Lodge & Shipley. The points are abridged from a list first published in extended form in the *Electrical World*, Vol. 70, No. 21, p. 997.

Advantages of the Individual Motor

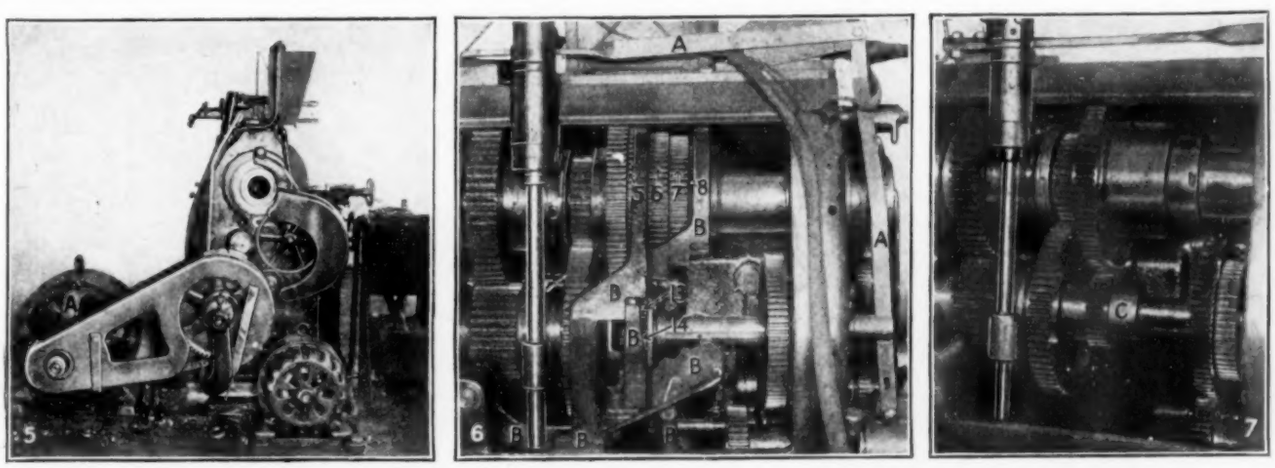
The advantages of the motor as here given indicate the machine-tool builders' attitude partly from the engineering standpoint and partly from that of actual experience under shop conditions. The individual motor may be said to possess advantages over lineshaft or even group drive because of low maintenance, low initial cost and low power losses, greater flexibility in being moved about the shop, ease in starting and stopping, closer speed control, more simple for reversing, special control available, clearance overhead for cranes, better lighting, machines readily set at any angle, easily adaptable to space requirements, avoidance of side pull by belts, special features for grinding machinery, each machine may have its own speed, overload protection by fuses or circuit-breakers and safety devices readily applied.

A Practical Example

Fig. 1 shows the clearness of the space over motor-driven machine tools'. Fig. 2 shows special bracket for mounting the motor rigidly to a machine tool. In Fig. 3 the extension of the main baseplate of a multiple-spindle drilling machine is shown for accommodating an individual motor. This view illustrates a case of belted connection with the motor. Fig. 4 indicates a method of mounting the motor to a machine where a geared connection is employed for the power transmission.

Some of the foregoing points will perhaps be clearer from the following practical example of the efficiency

[1]Figs. 1, 5, 6 and 7 are due to the Westinghouse Electric and Manufacturing Co.; Fig. 2 to the Wagner Electric Manufacturing Co.; Fig. 3 to the Bausch Machine Tool Co., and Fig. 4 to the Newton Machine Tool Works.



FIGS. 5 TO 7. CHANGES IN A BELT-DRIVEN MACHINE TO ADAPT IT TO MOTOR DRIVE

Fig. 5—Turret lathe changed from belt to constant-speed motor drive and later to adjustable-speed motor drive. Fig. 6—Starting and stopping lever and internal mechanism of the headstock when used with either belt or constant-speed motor drive. Fig. 7—Internal mechanism of the headstock for adjustable-speed motor drive

of motor drive[2]. This refers to some work done on a 24-in. turret lathe in changing from constant-speed belt drive, first to constant speed and later to adjustable-speed motor drive.

Through the medium of gears and levers 30 changes in speed were obtainable, the gear ratios giving ample driving power to the spindle, and the spindle speeds ranging from 6 to 180 r.p.m. The rapid traverse for the turret and carriage was gear connected to the constant-speed driving mechanism. When the spindle was stationary all driven parts were also stationary, not permitting the rapid traverse to be operated under such conditions.

The machine was changed to a constant-speed motor drive using a 975-r.p.m., 220-volt, direct-current motor, with a chain connection from the motor to the driving pulley, the motor being located at *A* in Fig. 5. By using the mechanical speed changes and levers the same spindle speeds were available as before. The motor was started gradually by a regular starting rheostat, and the spindle was started and stopped by a lever arranged to engage with the friction pulley. The rheostat served also as a safety device for the motor and the machine since it automatically released the lever if anything went wrong or if the motor was subject to an overload from any cause.

Starting and Stopping Lever

The starting and stopping lever connecting with the friction pulley on all of the drives of this lathe is shown at *A*, Fig. 6. This same figure also shows the mechanical speed changes and devices that were used when the lathe was belt driven, there being no change in this design for the constant-speed motor drive.

Later on the same lathe was changed over to adjustable-speed motor drive, a 220-volt direct-current motor, with a speed range from 450 to 1800 r.p.m., being used. Fig. 7 shows the mechanism of the headstock used with the adjustable-speed motor drive.

Comparing Fig. 7 with Fig. 6 it will be noticed that the gears numbered 5, 6, 7, 8, 13 and 14 have been eliminated, together with all parts marked *B*, and that the hub gear marked *C*, Fig. 7, replaces all the gears and parts eliminated. With the adjustable-speed motor drive the same chain connection between the motor and the friction pulley was employed and the lever *A*, Fig. 6, was used to start and stop the spindle.

With the adjustable-speed motor drive there are 96 spindle speeds available on the modified machine, with three mechanical gear shifts, that is, 32 direct speeds, 32 back gear speeds and 32 triple gear speeds, and the proper cutting speeds can be obtained for practically all cases ranging from boring a hole 1½ in. in diameter up to turning work 24 in. in diameter.

As the rapid traverse for the turret and carriage could still not be driven when the spindle was stationary a 3-hp. 700-r.p.m. 220-volt constant-speed motor was used as shown at *B*, Fig. 5. This auxiliary motor operates the rapid traverse and enables the operator to stop the spindle and take the piece of work out of the chuck while the carriage and turret are being run back to the starting point for the next piece.

[2]The writer is indebted to E. C. Brandt of the Works Dept., Westinghouse Electric & Mfg. Co., for the report on which this explanation is based.

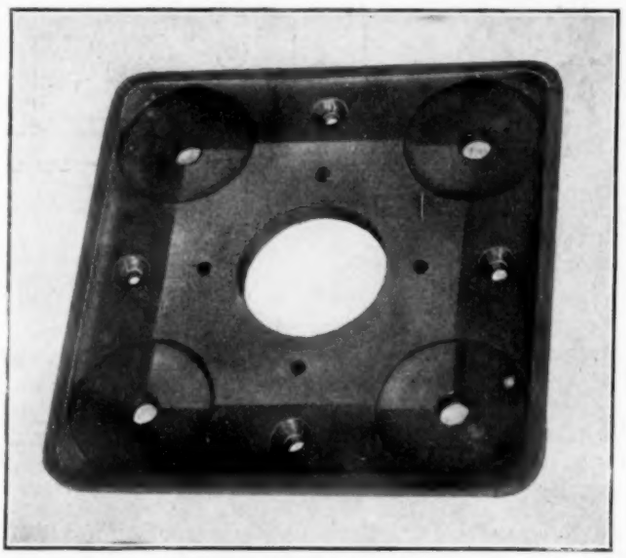
A Composite Seaming Die

By J. A. Lucas

The illustration shows a seaming die that is used on can-making machinery for setting the bottoms and tops of cans in place. Seaming dies are of many sizes and shapes, as each size and shape of can formed by the machine requires a die which conforms exactly to it. The die here shown is about 12 in. square and ½ in. thick.

A piece of tool steel of these dimensions would be somewhat difficult to harden without warping so badly as to render it valueless for the purpose intended, and even if it were possible to produce satisfactorily it would be comparatively short lived, as the wear is rapid, particularly at the corners.

To reduce the first cost, and particularly the maintenance cost, these tools in the larger size are built

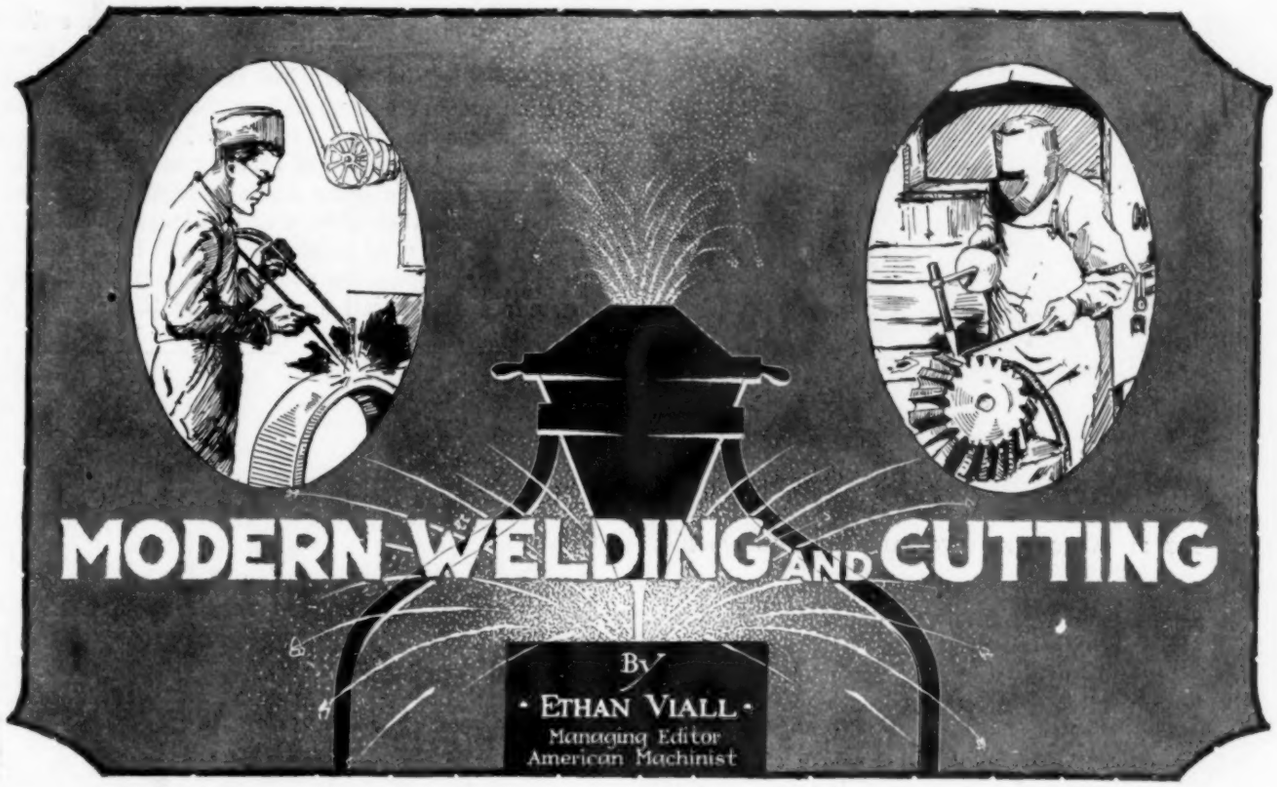


A BUILT-UP SEAMING DIE

up with a mild-steel core and tool-steel wearing strips which form the periphery of the die. The edges of the center piece are rabbeted to a depth of 1¼ in., the rabbeted portion being about ¼ in. thick. The tool-steel strips are rabbeted to match and are doweled to place with taper pins passing through both parts.

The large counterbored places to be seen near the corners of the die fit over locating plugs on the spindle of the machine on which the die is used. The die is used in conjunction with a pair of seaming rollers, one of which locks the bead on the edge of the can cover or bottom, while the other roller presses down the seam thus formed, making a tight joint.

When seaming a bottom in place on a new can, the seaming die revolves, while the position of the rollers, though the rollers themselves are rotating, is stationary with reference to the die. When setting a top in a filled can it is obviously necessary that the can, and consequently the die, should remain stationary, and in this case the head carrying the rollers revolves around the die. Though the making of large seaming dies in this way involves some rather nice fitting it is still far less expensive than making an entire new die of tool steel when the chances of the latter in the hardening operation are taken into consideration.



Thermit Rail Welding for Electric Systems

Rail welding is an interesting proposition, mechanically and otherwise. The directions given in this article are detailed, and taken with those which have been previously published they should furnish a clear idea of the process and facilitate its use in many fields.

PROBABLY no problem in recent years has received more consideration at the hand of traction companies than the subject of track construction and maintenance. Progress along this line has been continuous and expense has not been spared to obtain the best roadbed possible; heavier rails are being used and particular attention is paid to the foundation, ties and drainage; everything is of the best material and workmanship until it comes to joining the rails together, and here there usually develops the weak point of the entire system. This refers to the mechanical joints in common use. No matter how much care is taken in applying splice bars mechanical discrepancies and disadvantages cannot be overcome; the rail sections are seldom uniform and the American Society for Testing Materials has adopted specifications which limits a maximum difference in height to $\frac{3}{64}$ inch. Variable height in new rails is often unavoidable, as joint plates fitting one rail perfectly may not fit its neighbor.

There are many reasons why the mechanical joint fails to fulfill its function, which are not necessary to enumerate here. On the other hand the advantages of a welded rail joint, where circumstances will permit, are plain. While there are several systems by which rail joints may be welded, at the present time the Thermit method is the only one that absolutely eliminates the joint. It also has advantages in the modified joint-welding work. These advantages will become clear as our description of the actual processes develops. Briefly, the weld is accomplished by pouring the superheated steel obtained from the Thermit reaction into a mold surrounding the rail ends at the joint. This fuses with the base and web of the rail as well as with the lip and one side of the head. An insert cut from a rolled section of similar analysis to that of the rail itself is placed between the heads at the running face, and the lower part of this insert is melted into the Thermit steel. The mold is so constructed, however, that the head of the rail and the top part of the insert are not melted but are merely heated to a welding temperature, so that when the Thermit metal begins to cool and contract, thus drawing the rail ends together with tremendous force, the squeezing action on each side of the insert thoroughly

FIG. 53. ADJUSTING INSERT BETWEEN RAILS

FIG. 54. ADJUSTING TWO-PART MOLD TO RAILS

butt welds it into the head. When this has been accomplished the running face is ground to a true surface and the surplus metal ground out of the groove. The weld obtained in this way is so perfect that it is practically impossible to detect its location after the rails have been paved in.

In practice the welding is best done after the ties have been concreted. If the welding is done before the concreting it is somewhat difficult to keep the rails in perfect alignment and to proper surface after the temporary splice bars have been moved. The rails are spaced $\frac{3}{4}$ in. apart and must be thoroughly cleaned for a distance of 4 in. from each end. This can be accomplished by using a small steel-wire brush. The ends of the rail heads must next be cleaned and where necessary filed smooth so that when the insert is fitted the maximum amount of contact surface will be obtained. In other words the insert must be made to fit accurately. Following this the rails are brought to proper surface and alignment, care being taken to keep the rail ends a trifle high, so that when a straightedge about 30 in. long is centered over a joint there will be a space of about $\frac{1}{32}$ in. between the ends of the straightedge and the surface of the rail directly under it. This slight raising of the rail ends has been found necessary in practice, as it assures proper alignment and surface after grinding.

FIG. 55. RAMMING MOLDS ON A SQUEEZING MACHINE. WOODEN PATTERNS AND SHEET-IRON MOLD BOX IN FOREGROUND

FIG. 56. CUTTING HEATING GATE IN MOLD. FINISHED MOLD AND WOODEN PATTERN SHOWN IN FOREGROUND

The joint is now ready for the placing of the insert, as shown in Fig. 53. Various thicknesses of inserts must be kept on hand to fit the variation in gap brought about by temperature changes and other causes. With the inserts in position two part sand molds are applied, as shown in Fig. 54. These are rammed in advance on a foundry squeezing machine over a wooden pattern, the dividing line of the molds being in the center of the web. A squeezing machine being used for this purpose is shown in Figs. 55 and 56.

The pattern is so constructed as to form an opening around the rail ends in the shape of a collar into which the Thermit steel is poured. This collar is usually about 3 in. wide and varies from $\frac{1}{2}$ in. to $\frac{3}{4}$ in. in thickness, depending on the rail section to be welded. Pouring gates and risers are also provided for in the mold in a similar manner to those already described.

Recent improvements in the construction of the molds

used have been perfected to guard against runouts. A bead protrudes around certain parts, so that when the two halves are clamped together it is compressed between them and forms a safeguard against the liquid steel running out.

Before clamping the molds to the rails two cords of asbestos soaked in molasses are applied around the contour of the rail, one on each side of the joint, as shown in Fig. 57, and placed in such a position that they will come just inside the outer edge of the mold box. The molasses is sufficiently sticky to make these cords adhere tightly to the rail and form a very efficient luting all around the outside edge between the mold and the rail. As an additional precaution a small amount of fireclay is blown into the mold through the pouring gate by means of compressed air, as shown in Fig. 58, while the other openings are closed temporarily by inserting wooden plugs. Should there be

FIG. 57. APPLYING ASBESTOS AND MOLASSES STRIPS TO RAILS PREVIOUS TO PLACING MOLD

any opening around the edges of the mold the fire clay escaping through that opening will be caught by the molasses on the asbestos cords and the opening automatically sealed. When the air-pressure gage indicates that the mold is tight the wooden plugs are removed and all surplus fire clay blown out through a small blowout gate provided in the lower part of the mold.

Preheating

The rails are now ready for preheating, and must be brought to a bright-red heat. For this purpose a special portable heater is used.

The opening in the mold through which the rails are heated is situated about two-thirds from the top, so that the flame strikes the lower portion of the web of the rail and has the effect of heating the entire rail section uniformly. This preheating also accomplishes two other objects, as it bakes the mold and at the same time heats up a can of additions which are added to the Thermit in the crucible to improve the quality of the steel produced. This can of additions is placed on top of the mold in a special receptacle provided for the purpose in the riser opening, as shown in Fig. 59. As soon as the rails are red hot, the mold thoroughly dried and the can of additions heated to the proper temperature the burner is withdrawn and

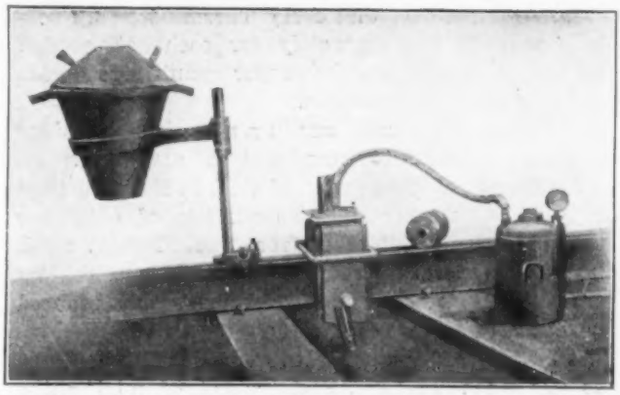


FIG. 58. FINAL LUTING PROCESS, BLOWING POWDERED FIRE CLAY INTO THE MOLD

the heating gate plugged with a sand core. The burner is then directed down the pouring gate in order to restore any heat that may have been lost during the plugging operation.

The mold is now ready for pouring, and the crucible is placed in position, the reaction started and the melt tapped, just as described for other work of this character.

The steel enters the mold on the lip side of the rail and thoroughly melts and amalgamates with the lip as well as with the web, base and one side of the head. No Thermit steel is allowed to touch the running surface of the rail, as the steel insert closes up the space between the rail ends except for a small opening of about ¼ in. from the outside of the head. The under part of the insert is thoroughly fused with the liquid steel and becomes a part of the fusion weld, as shown in Fig. 60.

As explained previously, when the metal in the weld begins to cool it produces sufficient pressure on each side of the insert, due to contraction, to thoroughly butt weld it in position so that at the end of the operation the entire rail is welded into one homogeneous mass. A finished weld is shown in Fig. 61 and in Fig. 62 is shown a number of operations going on at once.

One of the principal advantages of this type of weld is that it depends on a predetermined chemical reaction which is always uniform. The success of the reaction

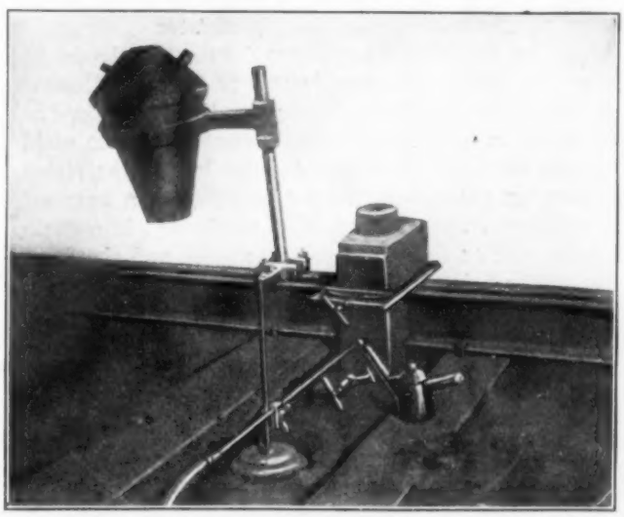


FIG. 59. MOLD AND CRUCIBLE CLAMPED IN POSITION READY FOR PREHEATING. BOX CONTAINING ADDITIONS SET IN RISER OF MOLD

is assured by the fact that every Thermit-welding portion is weighed out separately for each rail section to be welded and in just the proper quantity to obtain a perfect weld on that section.

The placing of the additions in a sheet-iron container is a fairly recent improvement and has resulted in not only obtaining a higher grade of steel in the weld than was possible formerly but also permits of obtaining a greater quantity of steel from the Thermit used. This in turn permits a weld to be made with less Thermit than formerly and has considerably reduced the expense of the welded joints.

The scheme of employing the additions as outlined is to use plain Thermit, and instead of mixing the additions of manganese, nickel and other materials for improving the quality of the Thermit steel throughout

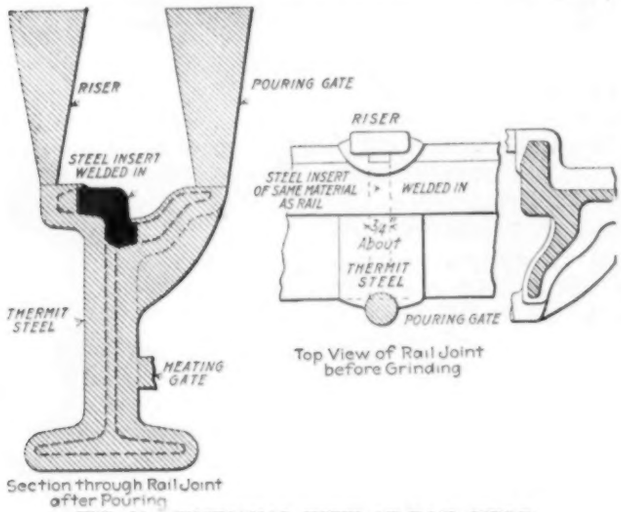


FIG. 60. SECTIONAL VIEW OF RAIL WELD

the Thermit itself these additions are now put up in the sheet-iron container which is placed on top of the mold during the preheating and is heated red hot by the waste gases. It is then placed in the center of the crucible and is melted down by the heat of the Thermit reaction.

This method enables the production of more steel from a given amount of Thermit without any sacrifice of heat, with the result that the cost of the welding portion of Thermit is considerably reduced.

After the weld has been poured *the mold should be left undisturbed for a few hours;* in fact, the longer it is allowed to cool the better, as the metal in the weld has time to become properly annealed. The mold boxes can then be removed, the metal left in the risers and pouring gates cut off by nicking with a hammer and chisel and knocking off. All sand, etc., is cleaned from the rail in the vicinity of the mold and the joint is ready for grinding.

As the steel insert is left a trifle higher than the rail section this excess metal must be ground off together with the excess metal left in the groove and on the outside of the head where the riser is removed.

This grinding can best be accomplished by means of the machine shown in Fig. 63. It possesses the advantage that the weight is concentrated over the grinding wheels so that a deeper cut can be taken. It also has attachments permitting of grinding in the groove of the rail and on the gage. If only a very few joints are being welded, however, the grinding can be very satisfactorily accomplished with a flexible-shaft grinding machine. In fact one of the great advantages of the Thermit process of rail welding is that a few joints can be welded almost as economically as a large number, and traction companies can do the work themselves wherever they please, and when the work is properly organized a gang of nine men can weld from 35 to 40 joints in a nine-hour day.

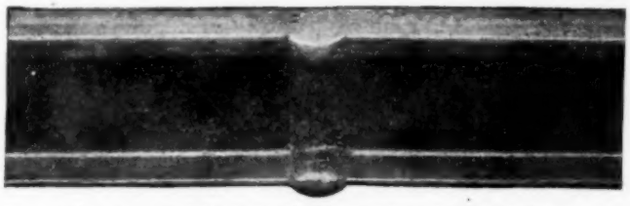


FIG. 61. FINISHED THERMIT FULLY WELDED INSERT JOINT

The simple and portable character of the welding outfit, including the grinding machine, is a strong point of merit, as one service car will carry all the equipment or it can be hauled on its own wheels.

The rail-grinding machine referred to was originally designed by the Thermit company for grinding Thermit-welded rail joints, but has proved very efficient for grinding out corrugations, pounded joints, and in fact anything that is required of a rail-grinding machine on an electric-railway system. An important feature is the derailing device which permits the removal of the machine from the path of traffic very quickly. The concentration of the weight over the grinding wheels has already been mentioned. By this arrangement deep or light cuts may be taken without danger of the grinding wheels chattering. The truck frame carries two axles. One axle is fitted with ordinary 22-in. car wheels and the other has eccentrically mounted 13-in. wheels. By means of sliding adjustments the wheels may be spaced on their axles to fit road gages of from 4 ft. 8½ in. to 5 ft. 2½ in. The grinding-wheel brackets have both vertical and horizontal movement to allow for adjustment to the work. The bracket also may be rotated so that the face of the grinding wheel may be adjusted to the surface to be ground. By a special arrangement of the motors used the machine

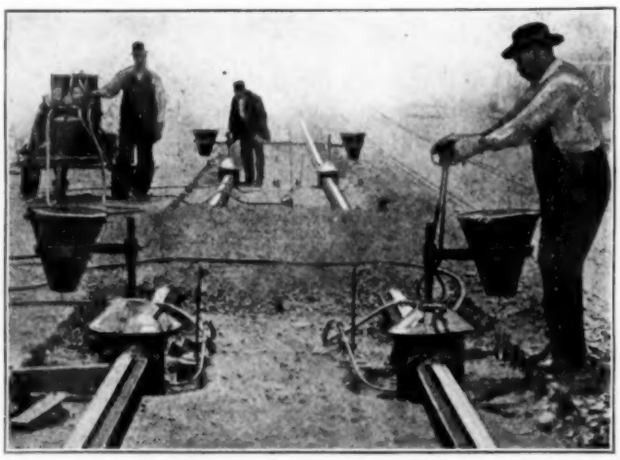


FIG. 62. PREHEATING RAILS, DRYING MOLDS AND HEATING THERMIT ADDITIONS, ALL IN ONE OPERATION, FOUR JOINTS BEING HEATED AT ONCE

can be driven forward at a rate of 2 or 4 ft. per minute and 6 to 12 ft. per minute on the return. A reversing switch permits speeds to be used in either direction.

Where it is desired to grind out a depression a special arrangement is used by which an accurate curve is obtained. The grinding wheels run about 1833 r.p.m., which corresponds to a peripheral speed of 6719 ft. per minute on a new 14-in. wheel. The grinding-wheel motors are rated at 3½ hp. and the propelling motor at 1¾ hp., and they are designed to operate on 500 to 550 volts. The derailing device operates by power and is quickly brought into use. The complete machine weighs about 6000 pounds.

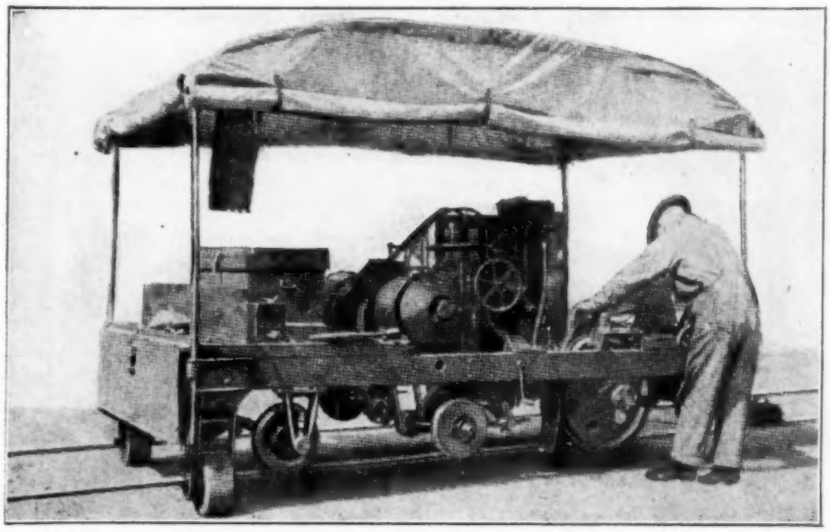


FIG. 63. RAIL-GRINDING MACHINE DERAILED UNDER ITS OWN POWER

The Jottings of a Journeyman

By F. L. Ess

While walking along the other day in that sort of a trance that often comes to men of a mechanical turn of mind when they are thinking out some problem I suddenly bumped violently into a man who was presumably similarly preoccupied. Looking up with some degree of impatience I met the solemn gaze of my old friend Joe Huse, who was a foreman in a large concern manufacturing valves.

"Better look where you are going," said Joe.

"Look yourself," I retorted, holding out my hand.

After the exchange of badinage usual between friends who have not met in years I suddenly recalled that I had recently seen Joe's name in the papers in connection with some patent matters.

"By the way Joe," I said, "how did you come out in your deal? I heard you had recently been allowed a patent on a valve and had sold it to your company."

"Well," replied Joe, "I was allowed a patent all right, but when it comes to selling it to the company I guess it was I that got sold."

"How's that?" I queried. "Your firm has the name of being pretty square sort of people to deal with. Did they try to put something over on you?"

"Oh, I suppose they are square enough. They are pretty good people to work for, but they seem to think that any ideas that their employees may happen to have ought to be turned over to them free of charge in consideration of their giving the employee a steady job."

"That may be all right with minor ideas or suggestions, but it doesn't seem quite fair with reference to things which they consider to be worth patenting."

"Now this thing I got up," continued Joe, "was something that they wanted pretty badly. It was an improved type of valve which they wanted to replace one that they had been obliged to abandon to avoid action in infringement. They had nothing to fill the gap except a valve that had been invented and patented by their former superintendent and on which they were obliged to pay a generous royalty; besides it was expensive to make. They knew I had got up something along that line and had the sketches at home, and they wanted me to bring them in, but I held back because I was afraid they would try to get it away from me.

"I was persuaded, however, to submit my sketches, and they seemed to like them very much. but when they got down to brass tacks the president of the concern, who conducted the transaction, did not seem inclined to give any more than he had to.

"I did not want to risk my job by holding out for a good figure and I finally let it go. Now, I suppose, the president thinks he has made a good bargain for the company, but I think that in the future I will keep my ideas to myself."

"But," said I, "they paid the old superintendent a good royalty."

"Yes," he replied, "and I think that was the reason that they let him go."

Now I don't know whether Joe's resentment against the president was justified or not. Perhaps the latter was the kind of person who likes to see a man stand his ground and would have had more respect for Joe if he had put up a little better front in the matter provided he did not carry it too far or get too exaggerated an opinion of the value of his invention.

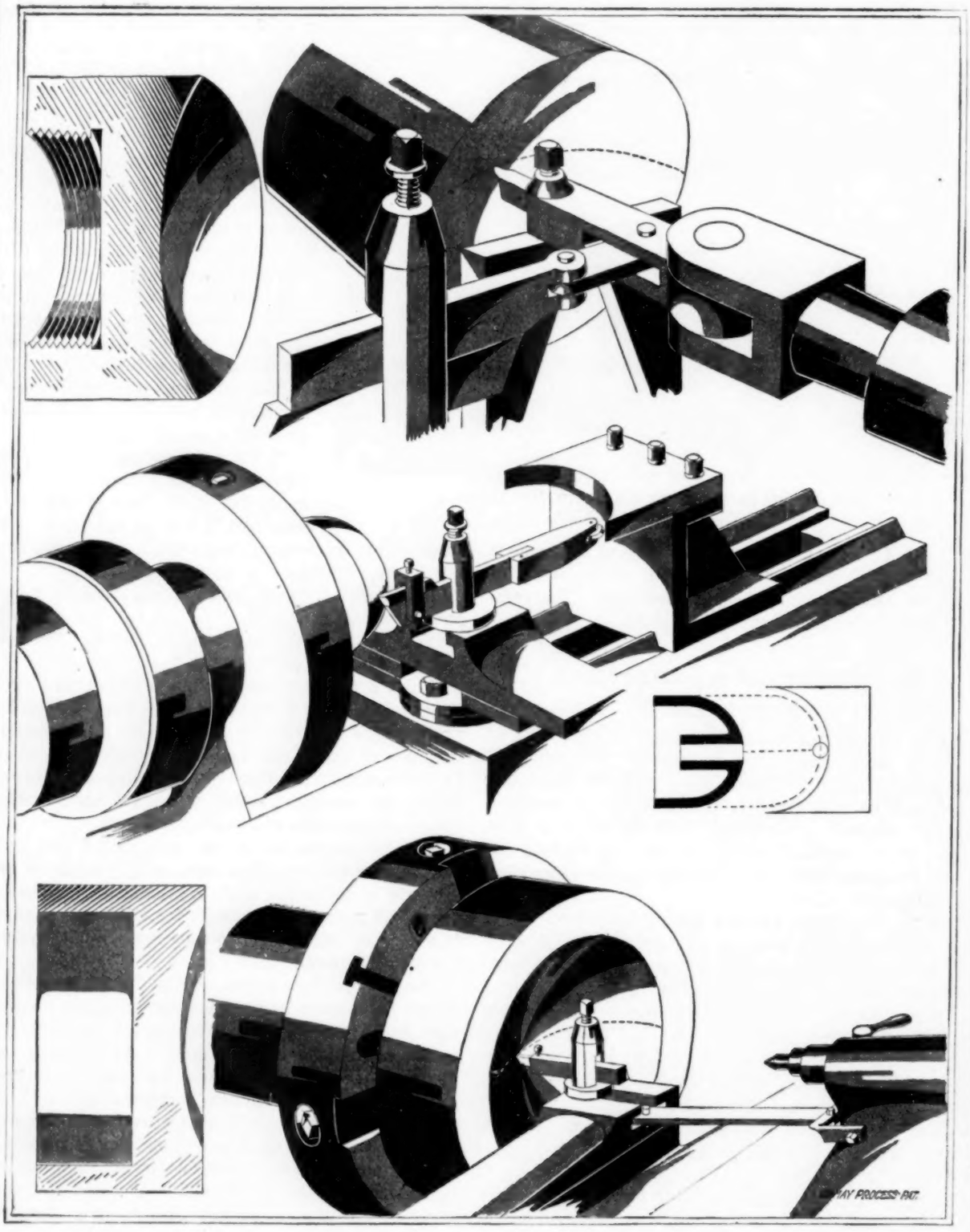
My own impression of the man, and I had worked for his concern, was just that, and I think he failed properly to appreciate Joe's viewpoint as a subordinate dependent upon his daily work for a living, yet wishing to show due respect for his superior without sacrificing his own interests.

Huse's experience makes me wonder just what course should be pursued by the workman who gets up patentable improvements on his employer's products. His employer would naturally resent anything that looked like an attempt on the part of the employee to use his knowledge of the product to "put one over" on the firm.

There are a good many angles to this puzzling question as to what is right and proper in such cases. It is not unnatural or uncommon—indeed it is quite the usual thing for the suggestions that result in improvement of the product of any firm to come from those who are in daily personal contact with them—and any information tending to enlighten the poor workman who naturally wants to get all he can for his ideas without endangering his job would be acceptable.

FOR SMALL SHOPS *and* ALL SHOPS

By J. A. Lucas



SPHERICAL TURNING METHODS

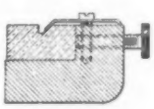
Optical Projection for the Inspection of Screw Threads—II

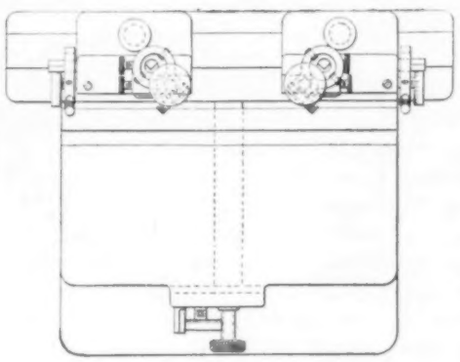
By JAMES HARTNESS
President Jones & Lamson Machine Co., Vice Chairman National Screw-Thread Commission

In this installment of the article by Mr. Hartness reprinted from "Mechanical Engineering" (formerly the "Journal of the American Society of Mechanical Engineers") a description and illustrations are given of a new and improved optical method for the accurate inspection of screw threads.

THE projection lantern has been developed to a point where it now gives at a glance the diameter, lead, form and a fair indication of the roundness and smoothness of the surfaces. In order to get all of these results it is necessary to use in connection with the projection apparatus a stage and tolerance chart laid out on a large scale to conform to the desired characteristics of the screw to be inspected.

The chart is so located that the profile of one or more threads of the screw may be projected on to the chart and a comparison made between the enlarged shadow thus cast by the thread and the form of thread and tolerances outlined on the chart. (A more detailed description of the projection apparatus and chart is given later.) The advantage of the projection method is that it is possible to see at a glance how a screw will fit in its threaded hole as represented by the tolerance chart on the screen. If only one thread is projected on the screen, this is raised or lowered by variation in diameter and displaced laterally by variation in lead. The combination of these two things must be known in order to know how the screw will fit into the threaded hole. If two threads are projected we have a knowledge of the parallelism or taper of a screw.





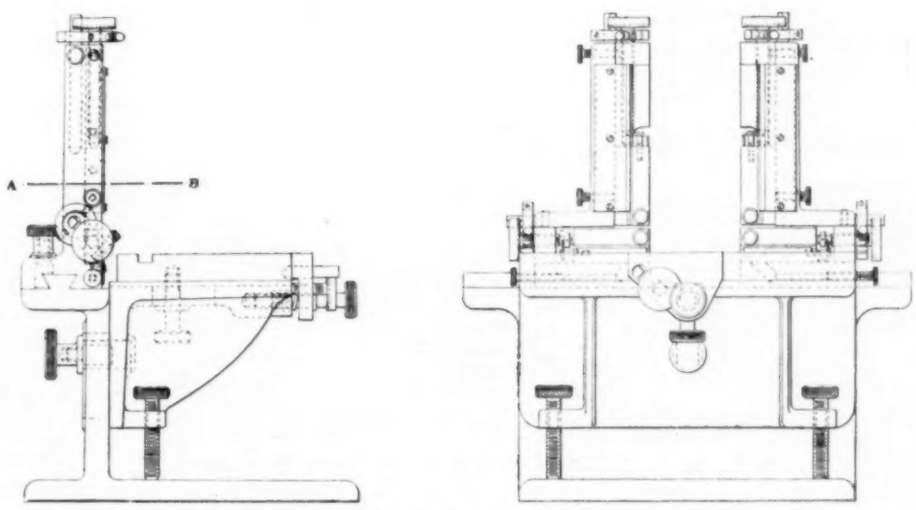


FIG. 1. PROJECTION MACHINE FOR INSPECTING SCREW THREADS

In the Progress Report of the Committee on Limits and Tolerances in Screw Thread Fits presented at the spring meeting of the American Society of Mechanical Engineers in 1918 tables will be found showing what reduction in pitch diameter must be made to offset certain errors in lead. For instance, the basic pitch diameter of the ¾-in. 10-pitch screw is 0.6851 in., and if the lead of the screw is true the pitch diameter may be made up to this full diameter; but if the error in lead is plus or minus 0.002 in. in the length of engagement then the pitch diameter must be reduced 0.0026 inch.

Even in the best work, however, such allowances for difference in lead are seldom calculated. We merely know that if the lead is off we must reduce the effective diameter.

By the use of the projection apparatus and the tolerance chart all elements excepting the density of surface may be seen at a glance. The resultant effect of the displacement in lead, diameter and angle to the boundaries established on the tolerance chart indicates the fit with a definiteness that will be beneficial alike to the producer and the purchaser, for it will make it possible for the purchaser to express in words and by diagram the exact boundaries within which the product must come. In addition to providing a measure for the lead and diameter the tolerance chart and projection apparatus provide a way by which it is possible to indicate the extent of variation in the form of the thread that will be tolerated. As the art of machine building advances and our methods for producing and gaging screw threads advance we shall doubtless soon arrive at a point at which we will find it desirable to indicate the difference in lead between the two component parts of a screw-thread fit. For instance, stress of work

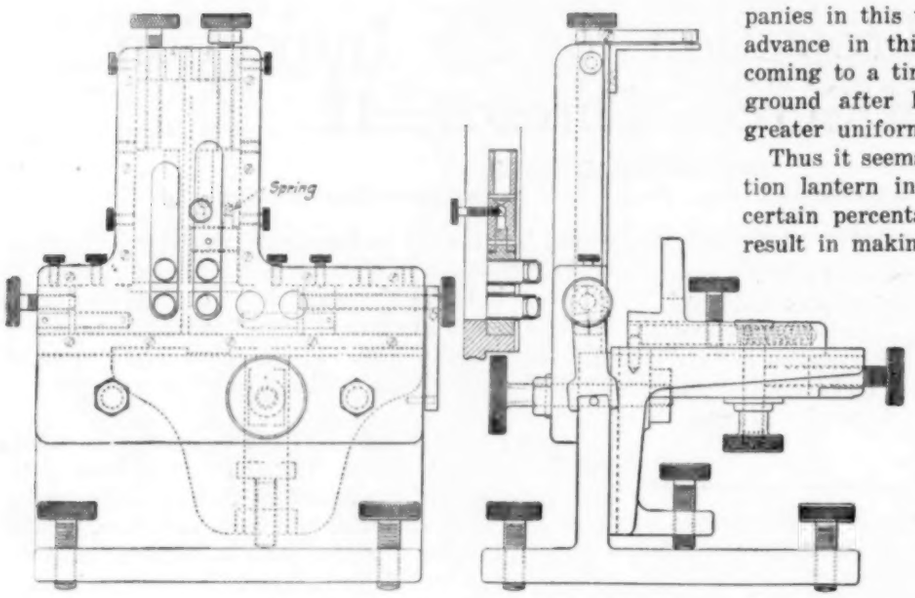


FIG. 2. MACHINE DESIGNED FOR SMALLER WORK THAN THE ONE IN FIG. 1

on a bolt or nut tends to lengthen the screw and compress the nut, so that if the leads of the thread in the screw and the nut were equal when free from stress there would be an unequal distribution of the load on the various threads engaged when the two members were under a heavy stress.

The stress on a setscrew compresses the screw, and to get equal distribution of load on each thread the setscrew should be long in lead when free from stress, and the lead of the bolt and nut should be longer in the nut than in the bolt.

To meet such demands the projection-lantern scheme furnishes a solution of one-half of the problem, for gaging is half of producing the work. If we have a practical and ready method of gaging it is much easier to produce the work. By the use of the projection apparatus the specifications may call for capscrews showing the displacement due to lead in one direction and setscrews in the opposite direction.

While the projection apparatus does not provide a solution for the measurement of the internal thread it does provide means for measuring the tap which is used for producing the internal thread, and although it is well known that the usual way of measuring a tap does not indicate the exact nature of the threaded hole that will be produced by that tap it is probable that a complete inspection of the tap by the projection methods will bring a closer harmony between the measurements of the tap and the threaded hole produced by it. Furthermore the advance of machine construction has demanded for a number of years a greater refinement in tap making, and although the most progressive companies in this work have shown a remarkable advance in this respect we are undoubtedly coming to a time when taps will be lapped or ground after hardening to bring them into greater uniformity.

Thus it seems that the advent of the projection lantern into the workshop for testing a certain percentage of the work produced will result in making our airplanes and other machines which operate under great tension for given dimensions more dependable and more efficient and at the same time get a greater return for the energy that is put forth in the workshop in producing these things, for no one thing has been a greater barrier to our progress, especially in our recent war activities, than the uncertainty in our methods of specifying, producing and testing screw threads.

Fig. 1 represents a machine in use at present, excepting as it has been modified from time to time with various forms of work supports. Fig. 2 indicates a machine designed to take a smaller range of work.

Fig. 3 gives a side elevation and plan of the general scheme, although not true to proportions. The lamp house, for example, is shown too close to the object. The apparatus consists of three principal elements; the machine, which holds the work and lens; the lamp house; and the chart holder, which serves as a screen on which the profile of the thread is projected. The chart holder slides on rails to and from the work in order to get the desired number of magnifications.

The general plan of operation starts with positioning the work and adjusting the light, work, lens and chart so that the image of a perfect screw thread will fall on the chart along certain lines.

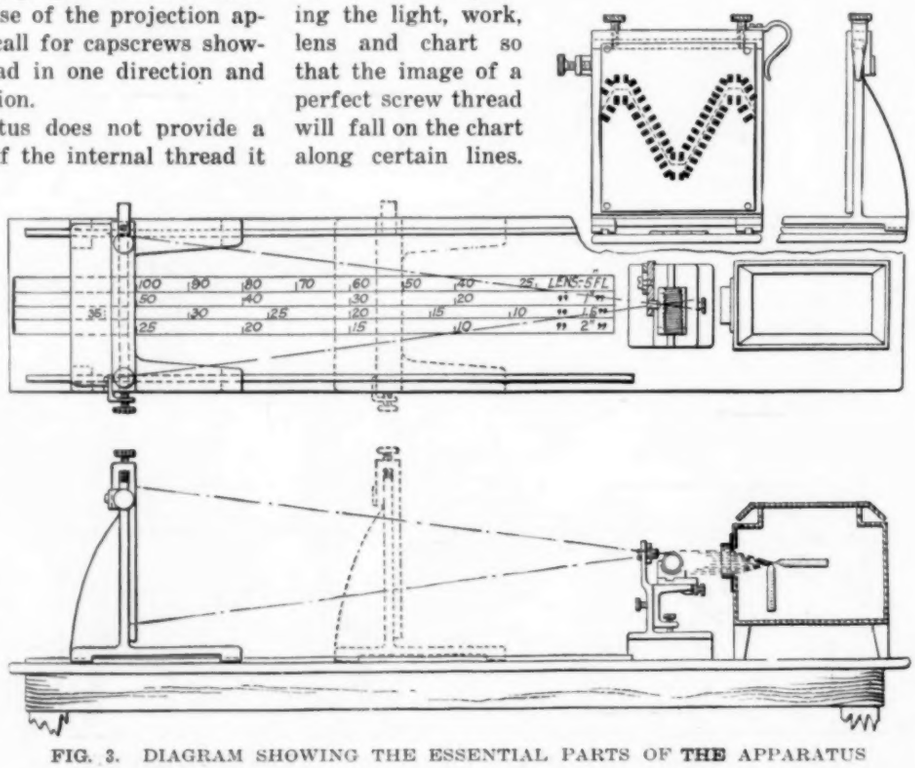


FIG. 3. DIAGRAM SHOWING THE ESSENTIAL PARTS OF THE APPARATUS

When we have no sample of work on which the thread is known to be satisfactory a standard screw-thread plug may be put in the work holder and used for setting the chart. After that the work may be placed in the machine, one piece after another, and instantly its shadow will reveal its diameter, lead error

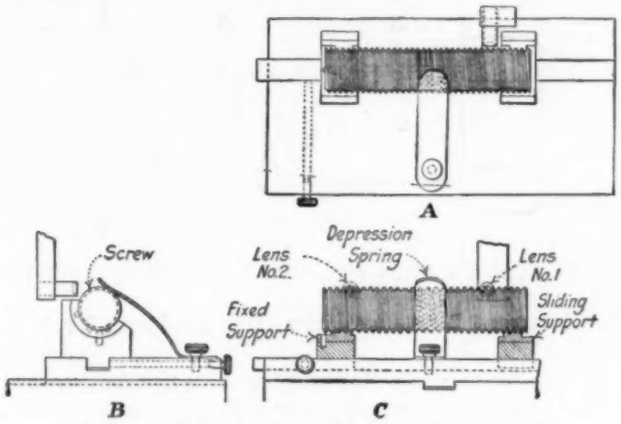


FIG. 4. THE WORK HOLDER OR CRADLE

and profile. If these fall within a certain range of tolerance on the chart the work is acceptable.

The simplest method of screw inspection projects the profile of one thread on a chart that has a maximum and minimum boundary. The maximum boundary represents the outline of the thread of the hole into which the screw must fit and the minimum represents the smallest acceptable diameter.

It has been found necessary, in order to meet the usual run of work, to mount the screw in one or two cradles consisting of nearly a half circle of a nut and embracing from one to three threads of the screw, according to the character of the work. With this form of mounting it is possible when projecting one of the

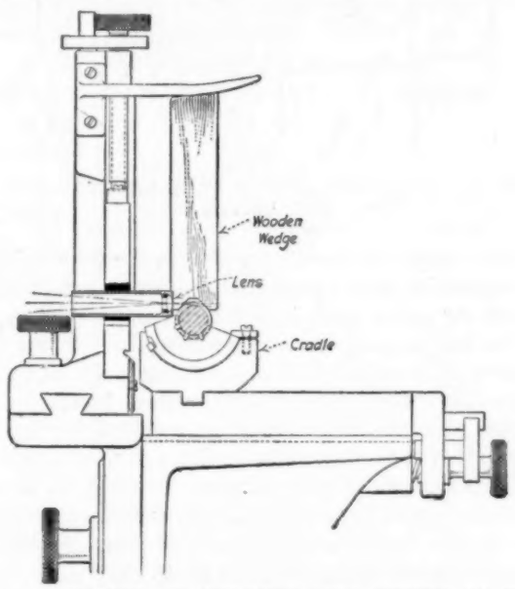


FIG. 5. METHOD OF HOLDING THE SCREW IN PLACE WHILE TESTING

threads to a tolerance chart to get some indication of the roundness and roughness by merely turning the screw in its cradle.

Three views of supports of this type are shown in Fig. 4 at *A*, *B* and *C*. The threads of the supports are interrupted with notches so that turning the screw in the thread will tend to carry out chips or other foreign particles that otherwise might be lodged in the thread. A spring is indicated for the purpose of giving the screw a downward pressure to hold the work firmly into its seat when it is being rotated by hand, the extent of this contact and pressure being different for different grades of work. On a ¾-in. rough screw I have used a wooden wedge which slipped readily into place and enabled me to get uniform results, as shown in Fig. 1. Fig. 5 shows the method of holding the screw in place for testing.

If the thread to be tested is very short and on a shaft or bolt of considerable length one of the cradles may be threaded to fit the screw and the other may fit the cylindrical body of the bolt or shaft.

Although this method is subject to the uncertainties due to fine chips or other particles becoming lodged in the cradles these things are more easily detected because the cradle is open and can be frequently inspected. Since a standard plug thread gage is the check on the

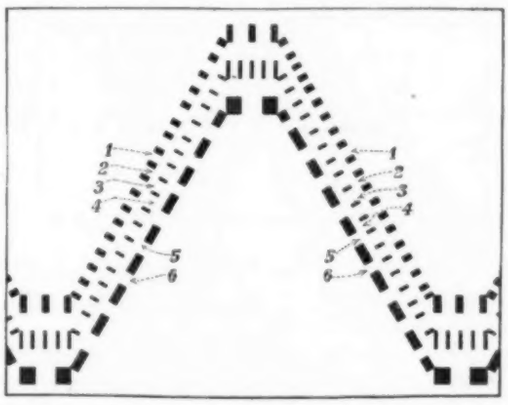


FIG. 6. A TOLERANCE CHART

adjustment of the projection apparatus it may be dropped into the cradle at frequent intervals.

The object of using a cradle instead of single points, such as center points or single-point contacts on the flanks or other parts of the screw, is to get a truer knowledge of the fit of the screw in the nut. The extent of area of contact of the cradle should be proportioned to the roughness of the work. Threads produced by the best methods of chasing on centers could use cradles with simple contact points.

Cradles are better than center points because 0.001 in. variation in diameter is fully shown on the chart, whereas by the use of center points with the projection of a single thread 0.001 in. would show a variation on the chart of only half that amount, and although by confining the projection to one thread with parts of two valleys a high magnification of 200 will give a displacement of 0.2 for each 0.001 in. of variation the fact remains that it is desirable to get the best result with the minimum handicap. For instance, a small chip on a center point, when one is looking for an error of 0.0005 in., is more serious than if the chip were imbedded in a cradle.

The condenser lens may be a simple planoconvex or it may be a combination of lenses to gather rays at a wide angle and condense them into a very small bundle of parallel rays. The essential thing of course is to have the rays travel in a parallel direction when they

reach the screw thread, striking the screw thread at the angle of the helix in order to present the sharpest profile for the lens.

In order to bring the screen as close as possible to the operator I prefer to use a lens of very short focal length. For instance, for ½-in. size I am using 0.43 in. focal length, and this could be conveniently used for $\frac{9}{16}$-in., but for ¾-in. screws and larger the outside diameter of this lens would conflict with the sides of the screw, making it necessary to cut away part of each thread.

The exact form of the tolerance chart will vary with different requirements, but I prefer a chart on which the boundaries indicated have stated gradations. For instance, for a screw thread of 10 pitch at 200 magnifications the outline of the thread form measures 20 in. between centers of crests of thread, and I produce a chart by drawing these forms in light pencil marks in steps spaced at 0.8 in., which amounts to 0.004 in. variation of screw thread, for at 200 magnifications we have 0.2 in. per thousandth of an inch. Such a chart is shown in miniature in Fig. 6.

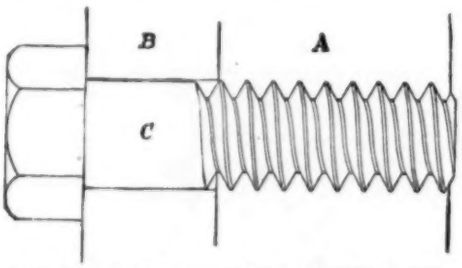


FIG. 7. AN IDEAL SCREW-THREAD FIT

Inasmuch as it is not easy to locate the shadow in relation to straight lines I use black dots having a vertical width of 0.8 in., which amounts to approximately a width of ⅜ in. on the flanks of the thread. These dots are made of different lengths so they may be readily recognized in the partial light of the projection room. The light of the projection room should be adjusted to see the black dots even in the shadow and yet not too light to dim the shadow.

By numbering the lines of the charts from 1 to 6, beginning at the upper and running to the lower side, we have means for recording if necessary the measurements of a screw. For this purpose we would set up the instrument with a standard plug gage or other perfect thread so that the shadow of this perfect thread would fall on line 5, and this would constitute the largest size that would be tolerated for free fits, the plug being the basic diameter.

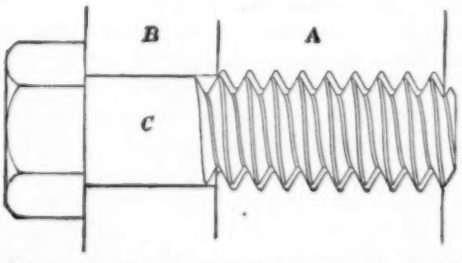


FIG. 8. SCREW SMALLER THAN THE THREADED HOLE

Let us assume that the allowable tolerance at the pitch diameter of a 10-pitch screw is 0.008 in.; that is, that the screw may be up to the full basic standard line 5 or it may be 0.008 in. smaller, in which case the shadow should not proceed farther than line 3. Then by placing one piece of work after another in the holder if the shadow falls within these boundaries of 3 to 5 we know its size is acceptable. If its shadow falls below line 5 toward No. 6 we know it is too large for that grade of fit.

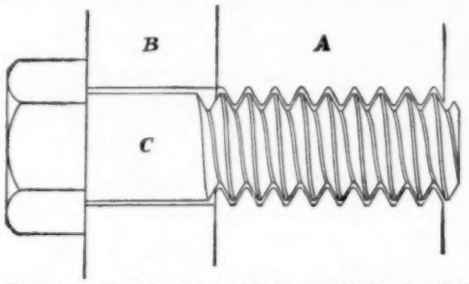


FIG. 9. SCREW OF FIG. 8 PLACED IN CENTRAL POSITION

The distance of the chart holder from the focal center of the lens must be as many times the distance from the focal center of the lens to the profile of the thread as the number of magnifications required. If the focal length of the lens were 1 in. the screen would have to stand away 200 in. to get a magnification of 200 diameters. With a 0.43-in. focal length we get 100 magnifications at 43 in. and 200 magnifications at 86 in. At a distance of 86 in. the shadow can be seen by the operator.

I am aware that in astronomy and other sciences using lenses, it is the novice that goes to the higher magnifications, and that the magnifications should not be greater than required, as the best result is obtained by the lowest magnification that will give the proper definition. And while I am aware that those who have been in this art for some time in testing gaging devices advise the low magnifications it would seem to me that there may be a special reason for using large magnifications in this scheme for testing the work itself.

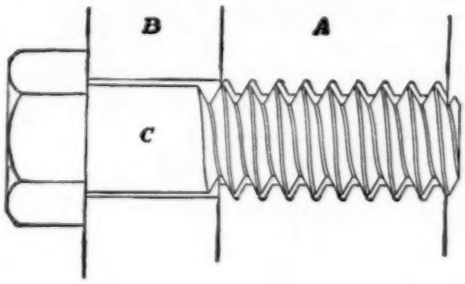


FIG. 10. STANDARD SCREW IN HOLE THREADED TOO LARGE

In this plan we have little or no occasion for projecting more than a single profile, or if we project more than one of the threads we superimpose the shadows so that the dimensions of the chart may be kept down to about 25 in. square for the run of work of standard threads up to 8 pitch with magnification up to 200.

Figs. 7, 8, 9, 10, 11 and 12 illustrate three elements of an ordinary screw-thread fastening. *A* and *B* are pieces to be forcibly held together by a cap-screw or bolt *C*. A hole is drilled in *B* large enough for the whole of the screw to pass through it, excepting the head, and *A* has a tapped hole into which the screw is turned.

Fig. 7 represents an ideal screw-thread fit in which the flanks of the thread of the screw and the threaded hole closely fit the entire length of the screw.

Fig. 8 illustrates an extreme example in which the screw is smaller than the threaded hole so that the threads engage only three-quarters of the entire depth of the full engagement.

Fig. 10 illustrates a fit in which the thread diameters are the same when measured on the pitch line, but

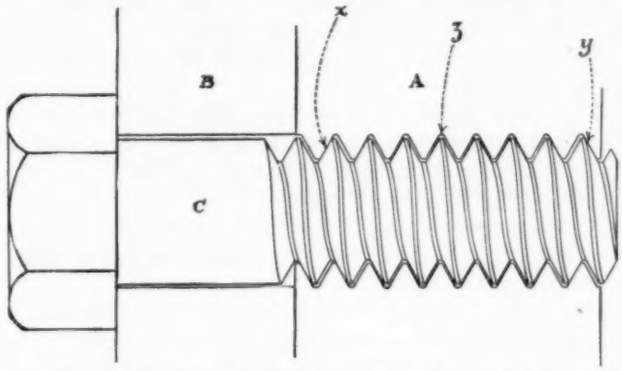


FIG. 11. LEAD OF THE SCREW GREATER THAN THAT OF THE THREADED HOLE

shows an example of a threaded hole in which the crests of the thread are not up to the full size owing to the hole having been drilled larger than the root diameter of the tap which produced it.

Fig. 11 shows a screw-thread fit in which the diameter of the screw is a trifle smaller than the diameter of the threaded hole, but the threads are not equally spaced, so that it is just barely possible to turn the screw into the threaded hole, for it will be seen that the flank of the thread at x and y bears in opposite directions, while the flanks of the thread at z stand clear.

Figs. 8 and 10 show the flanks of the thread properly engaged; that is, each thread bears its proportionate part of the load; whereas in Fig. 11 the whole load comes first on a single thread at x. In practice of course ordinary differences that appear in lead result in the stress crushing down the first thread at x and gradually working back until they may be distributed the entire length, but not equally.

A reversal of the difference in lead, that is, making the thread of the bolt shorter than the thread in the threaded hole, puts the burden of the work first on the thread at y, and then gradually, either through crushing down of the first threads engaged or by stretching out of the length of the bolt, brings a distribution over the other threads.

In making screw-thread fits we have not only the element of difference in diameter with true leads, but we have combinations of lead errors and diameter variations. It is obvious that with perfect lead the diameters must correspond to insure a depth of engagement that will prevent stripping under its working stress, and in addition to this if the screw is one that is frequently adjusted and must have good wearing qualities the depth of engagement must be great enough to provide ample wearing surface.

In addition to the foregoing elements we have to consider the form of the thread. In Fig. 12 is shown a threaded hole in which the thread is of a blunter angle than the thread of the screw, and while this is not as serious a matter as may seem at first glance, for it has been found perfectly practicable for ordinary fastenings to use a 55-deg. Whitworth thread in a 60-deg. U. S. Standard, the fact remains that it is one of the elements that we must consider in determining the dependability of a screw-thread fastening, for the thread under stress must be squeezed into a shape that will produce a uniformity of contact over a fair amount of the flank surface. Our system of screw-thread gaging should take into consideration form as well as diameter and lead.

The foregoing figures illustrate the three elements A, B and C as they would appear when screwed together under a light stress. No attempt has been made to show the various degrees of change that take place under the enormous stresses of the work, although we are coming to a state of machine construction which demands a consideration of the form of thread when under stress. For the purpose of illustration and comparison of the optical gaging system with the tactile gaging system, that is, the system in which we see the condition of a screw as against the system in which we try to determine it by the sense of feeling, we will for the present ignore such stresses.

If we substitute Fig. 9 for Fig. 8, in which a small screw is shown in the threaded hole, but instead of being pulled to one side it stands clear, showing the amount of clearance there would be around each side of each thread—if we will take this for Fig. 8 we will find that the various fit conditions can be found by glancing at the thread at the end of the engagement; for instance, at point y or point x.

Since the error in lead is equally divided between the opposite ends of the length of engagement it is the end threads that tell us the story.

In the optical-projection method we so locate the screw before the lens that the shadow is thrown on the

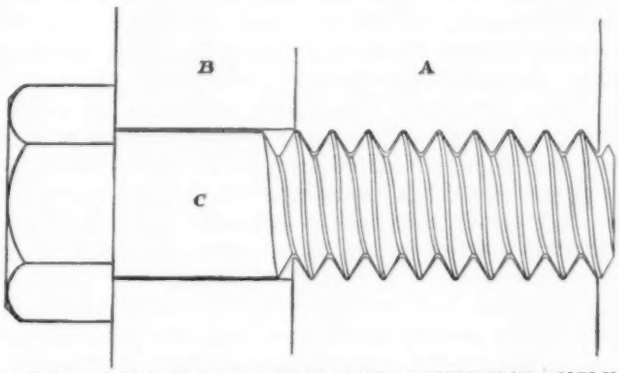


FIG. 12. THREADS OF SCREW WITH DIFFERENT ANGLE FROM THREADS OF HOLE

screen. A lateral displacement of the shadow will clearly indicate the lead error, and a vertical displacement a variation in diameter. The combination of the two will locate the shadow of a single profile on the chart in a way to indicate the condition at the end of a thread engagement of a given length. This tells the whole story of the resultant effect of diameter, lead and form of thread, for one of the boundaries of the chart may be considered as the interior profile of the threaded hole.

The average run of work with the projection lantern will present some new thoughts to the inspector's mind.

He will see that the lead is not uniform. In the length of a 3-in. screw the lead at one end of the screw may be shorter than at the other end. He will find that many screws are not round and some are very irregular and mountainous on the surface; not that these elements have been created by the projection apparatus, but merely that they have been brought clearly to view and should be recognized by any system of gaging that has for its ultimate purpose determining the dependability of the screw.

Rotating the Work

Rotating the work in its holder brings out irregularities. If the screw is of good form its shadow will remain stationary on the chart. If the thread is drunken, out of round or very irregular the shadow will move. A ragged surface also appears in the unevenness of the line, and frequently the inspector is confronted with the necessity of determining what part of the line he is to designate as indicating the real working diameter of the screw. It is not unusual to find one of the flanks of the thread instead of presenting a straight profile shows for instance a ridge near where the crest of the thread is rotated.

This condition has always existed in screw threads, and it is for us to recognize that the projection method merely shows how deceptive has been the gaging system which depended on the tactile sense or sense of feel of the gage.

In gaging this ridge would play an important part in eliminating shake, and yet the screw might be under size so far as its holding capacity is concerned.

When we see the displacement of the thread laterally, that is, if we assume that the profile of the thread on one side (Fig. 6) is on No. 4 boundary and the opposite side on No. 5, we will know that its lead is off to that extent, and that when turned into a nut the full length of the nut it will feel the same as a perfect thread. But as a matter of fact the slack will be taken up by opposite sides of the flank at opposite ends of the nut, while the middle may not be in contact.

Let us understand that line 5 represents the inside of the nut or at least the upper boundary for the screw. In order to get a perfect indication of the fit of an inaccurate rate lead in a perfect nut it is necessary for us to see that our holder which positions the work is adjusted in relation to the length of the engagement of the thread in the nut or in the threaded hole. For instance, if the lead is long or short we know that as it screws into the nut or threaded hole the difference in lead will cause the screw to fit in the nut as shown in Fig. 10, if the screw is longer than that of the nut, and on the opposite sides of the threads if the screw is shorter.

Now we must adjust our holding means so as to get a view of the thread at the end of the nut, which of course determines the closeness of its fit.

In Fig. 4, previously referred to, are three views, *A*, *B* and *C*, of a screw located in the cradle of a projection machine. In order to make the view projected on the chart duplicate the conditions in the nut it is only necessary to see that the longitudinal distance between the distance of the fixed support and the lens (position 1) is equal to the length of engagement of the thread in the threaded hole. (If the screw were held on center points instead of on a cradle this fixed support would be one-half the length of engagement.)

It will be understood that the fixed support locates the screw in its longitudinal position as well as laterally; that the sliding support, although holding the screw in the right focal distance from the lens, adapts itself to the position of the thread which, if the lead is true, will be the same as a standard thread, and if the thread is short or long will move endwise without changing the vertical gage of the screw. The projection through the lens will then be displaced vertically if there is a difference in diameter, and laterally if there is a change in length of lead.

The combination of these two when the distance to the fixed support is equal to the length of engagement gives a definite knowledge of the fit, and while it may be disturbing to know that the fit is not a fit in the true sense of the word, that it is a misfit in 99½ per cent. of our work, it is best to know the truth if we are to make our machines dependable.

A lens located in position 2 can be adjusted to throw its shadow simultaneously with lens 1; or a shutter may be used to alternate these two. The object of lens 2 would be to check the parallelism of the screw. If the vertical position of the thread projected by lens 2 corresponded to the vertical position of the thread projected by lens 1 we would know that the thread was parallel.

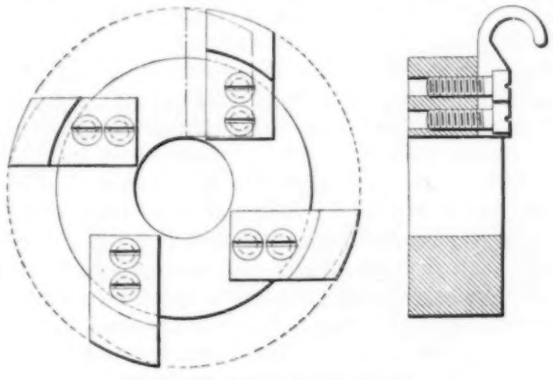
If it were desirable to have this test for each screw that went through the instrument its shadow could be so located as to fall two numbers lower than the shadow from lens 1, so that the range of its position would be from line 1 to line 3 on the chart, Fig. 6, while the range of the other position would be from 3 to 5, and the uniformity of the average distance between these would constitute an indication of parallelism.

The essential thing in gaging the rougher screws is to see that the screw is held down in its supports with sufficient pressure to insure good contact.

Relieving Wood-Working Cutters

By G. James Carr

The sketch shows a fixture for holding wood-working cutters when forming and relieving them in an engine



THE RELIEVING FIXTURE

lathe which has no relieving attachment. The desired amount of clearance can be obtained by setting the cutters back from the center more or less as may be required. This also gives a more uniform clearance curve and eliminates danger of the tool digging in.

Routing Machine of Special Design

SPECIAL CORRESPONDENCE

The bow drill used for making holes and cutting recesses in such materials as come within its scope represents one of the most primitive stages of tool design, and, despite the developments of later periods, it still remains a wonderfully efficient tool for operations to which it is adapted. This article describes a machine constructed along modern lines in which advantage is taken of the principle embodied in the bow drill.

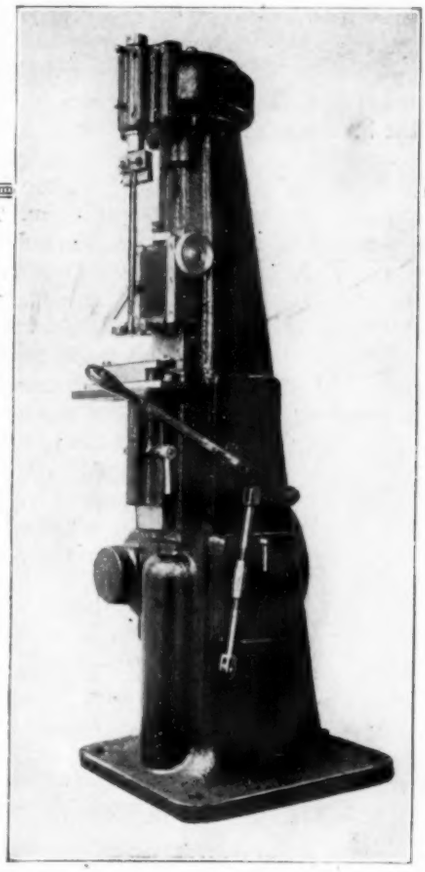


FIG. 1. SPECIAL ROUTING MACHINE

AN INTERESTING machine designed for routing out narrow channels, grooves, irregular openings and other forms in small parts is the one shown in the cuts in this article. Fig. 1 shows the completed machine and the drawing, Fig. 2, illustrates important features of construction.

This machine makes use of a special form of cutting tool, which will later be more fully described. For the moment it may merely be stated that the tool is rapidly rotated through several turns in one direction, then reversed and rotated as rapidly and for an equal number of turns in the opposite direction, this cycle of movement being continued so long as may be necessary to complete the operation. The tool during its operation first one way then the other is guided in a form plate containing the outline of the opening to be cut in the work, and the work itself is fed upward to the cutter by means of a vertically adjustable slide on the machine column, this slide and the work table which it carries being actuated by a hand lever operating a gear train which engages with a rack at the rear of the work slide. The cutting tool, the work slide and the operating lever for the latter are shown clearly in Fig. 1.

The mechanism for actuating the spindle will be best understood upon examination of the line drawing, Fig. 2. This spindle is a short member journaled in suitable boxes which are fitted into the head attached at the top of the column, which here develops into a cylindrical shell to house in the combined driving gear and clutch for operating the spindle.

Pinion teeth on the spindle at *A* engage the driving gear *B*, which is bored to form an internal cone to receive the clutch member *C*. The part *C* is fitted onto the taper end of the vertical shaft *D* and secured by a key and nut. The shaft passes down through the long sleeve hub on gear *B*, which runs in two sets of ball bearings as shown. The shaft is a running fit in the gear sleeve and is provided at the top with oil channels for lubrication of the bearing surfaces. When the shaft is lifted to release the clutch from its seat in the gear the latter is allowed to come to rest and the clutch shaft then runs in its own bearings until the gear is again set in motion by dropping the clutch into engagement. The gear and spindle may thus be rotated intermittently and in either direction by suitable control of the clutch shaft.

A pinion *E* is keyed to the lower end of shaft *D*, and a rack *F* at the rear meshes with this pinion. The rack is secured to a horizontal slide that is actuated by a crankshaft and connecting-rod. At each revolution of the crankshaft the rack causes the pinion *E* and the vertical shaft to make a half turn and back to its original position so that the cone *C* at the top of the shaft constantly turns back and forth through this arc. The proportions of the gear *B* and the pinion *A* are such that each movement of gear *B* gives the spindle three complete revolutions in each direction; that is, for every revolution of the crankshaft the spindle is driven three turns one way and then three turns in the opposite direction.

By reason of the changing angularity of the connecting-rod the tendency is to start the rack slowly and impart to it a gradually accelerating rate of movement until the center of the travel is reached, when the movement is gradually retarded to the end of the stroke. This results in an easy reversal of the driving gear on shaft *D* and the cutter spindle itself, correspondingly lessening the stresses on the driven parts.

The lower end of the driving shaft *D* is carried in a ball bearing *J* mounted in a vertically sliding member *K*, the latter having a limited amount of up-and-down movement in its guide in the supporting sleeve *L*. The gear *E* is keyed fast to its shaft, as indicated, and travels up and down when the shaft is lifted and lowered, therefore the face of the gear is made somewhat wider than the face of the rack with which it engages. The object of the vertical movement for the shaft *D* is of course to operate the cone clutch at the top. In either position of the shaft the rack *F* has a full bearing upon the wide face of the pinion *E*.

The hand lever shown at the side of the machine in Fig. 1 operates a rock shaft that is connected through the medium of a series of suitably adjustable links

and levers with the sliding support *K*, Fig. 2, so that movement of the hand lever results directly in vertical movement of the driving shaft *D*. When the lever is pressed down the clutch is engaged and at the same time an upward movement of the work table is effected. When the lever is raised to lower the work from contact with the cutting tool it at the same time causes the spindle shaft *D* to be raised, thus releasing the clutch and stopping the spindle.

The work table proper may be adjusted for height independently of its slide by releasing the binder handle

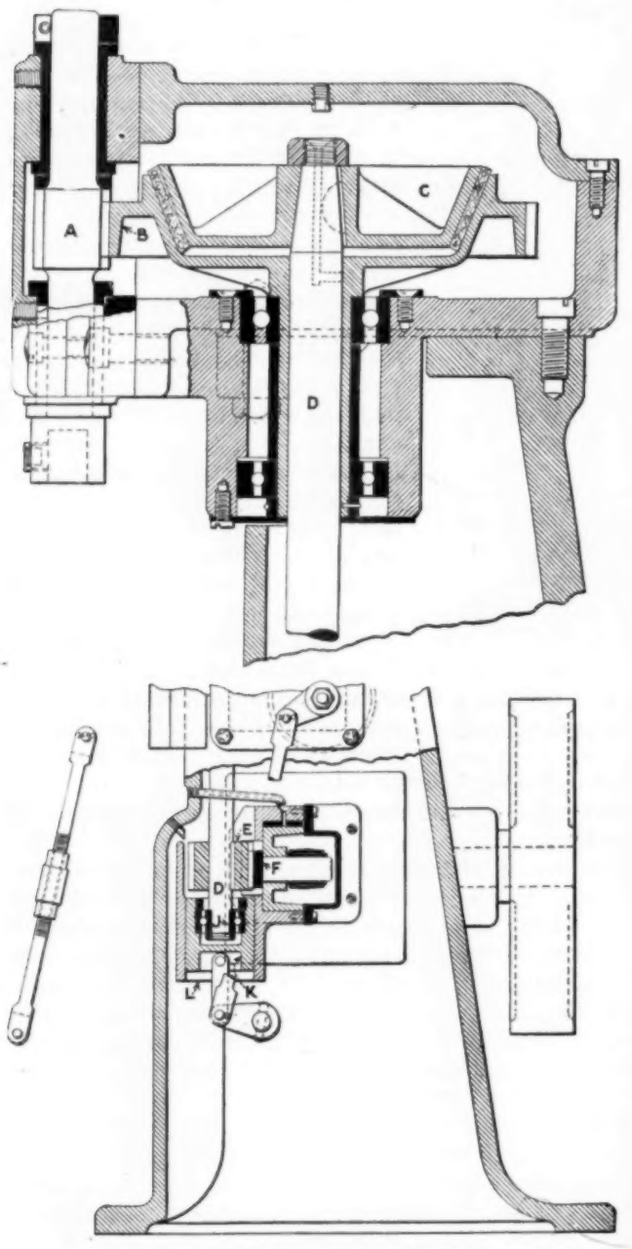


FIG. 2. DETAILS OF MACHINE

and setting the table at any position required. This provision for adjustment is shown distinctly in Fig. 1. The table is here represented with a fixture in place for holding the piece to be operated upon.

The cutting tool used with this machine is in the form of a spring tool or wabble device that is intentionally made so that its working end swings well out of center and thus bears always against a guide plate by which its path of cutting is controlled. The tool is shown by the sketch Fig. 3, which represents the long, slender shank made somewhat to resemble the curve of a violin bow. The upper end of the device is enlarged to fit the chuck, while the lower end is formed to provide a holder for the cutter. This enlarged lower end is of rectangular cross-section, and the portion of the shank immediately above is of small circular section to permit it to follow closely the contour of any pattern that may be used in the guide or form. The cutting tool itself may be triangular, as in the sketch, or it may be diamond shaped or of other form to suit the character of the cut to be made in the work.

The guide or form for controlling the contour produced by the cutter is attached to a support on the face of the column and is adjustable up and down by means of knurled head screws which may be seen in Fig. 1.

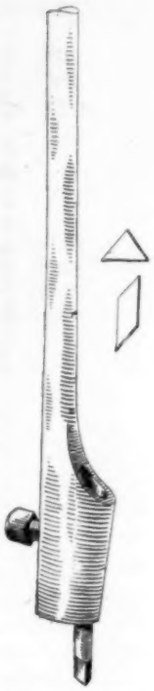


FIG. 3. THE TOOL

This machine is used for such work as cutting in the openings in knife handles, etc., for shields, or "shielding" cuts as they are called, and is the design of Arthur J. Briggs of Syracuse, N. Y. An elementary method of doing such work is shown in Fig. 4, which illustrates a workman using a bow drill with a split tool for the cut. The drill is supported at the outer end by a center which runs in a countersunk opening in a plate attached to a belt around the operator's chest. The work to be cut out is shown attached to a block

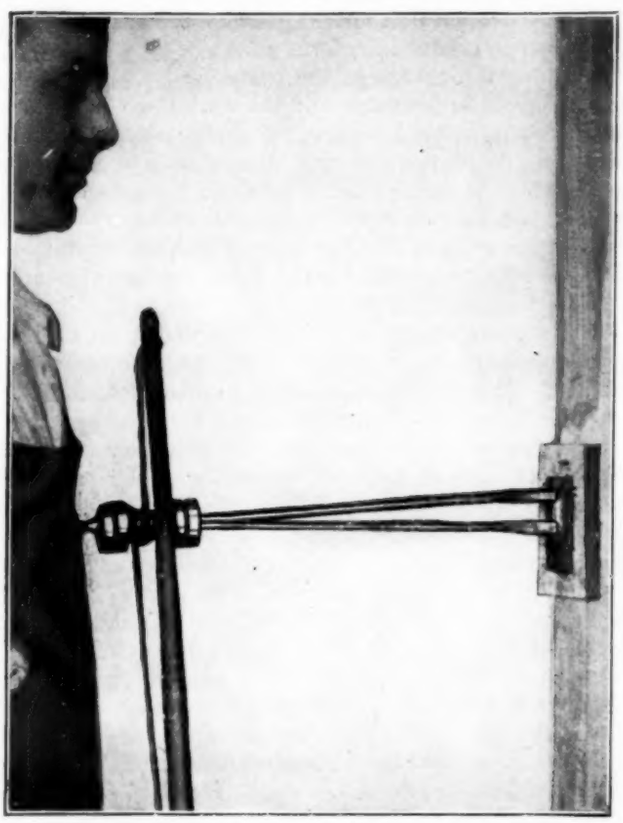


FIG. 4. OLD WAY OF DOING THE WORK

which is fastened to the wall. In operation the split, or divided, cutters on the ends of the two rods or spindles tend to spring apart and are therefore held by their spring action against the guide plate while revolved by the bow drill, so that the form of the opening in the guide is reproduced in the work.

The Next Move—Human Interest

By Harry Senior

There was an article in a recent issue of the *American Machinist*, page 213, that was so surprising that it left me fairly gasping for breath. A Mr. Godfrey—John R. Godfrey his name is—has apparently made the astounding discovery that intelligent workmen who have followed a certain line of business for years know at least as much about that business as the highly trained efficiency expert who until last month or so didn't know there was such a business.

There have been intelligent workmen (most all skilled workmen are intelligent, Mr. Godfrey, only the intellect of the expert being on a so much more superior plane the latter has never stumbled on this fact)—there have been, I say, such workmen who have suspected this to be the case ever since the days when everybody knew it—the day when Frederick W. Taylor turned all preconceived notions of intellectuality inside out by discovering that a trained gorilla could carry more pig-iron in 47⅝ sec. than a man could—but they have in later years carefully concealed their suspicions lest the fierce white light of popular belief should find them out and show them up for ignoramuses or ignoramii, whichever it is.

Mr. Godfrey does not write like a recalcitrant workman whose resentment of some real or fancied wrong has forced him into a position of defiance of public opinion, but rather like some member of the business world whom the stresses of the last four years has brought to the realization of a great truth.

Mr. Godfrey says: "We have made time studies and motion studies to try and save seconds when we might have saved minutes and hours by getting the coöperation of the men," and "We have assumed that all the brains of the establishment were tied up in the craniums of a few men, some of whom knew almost nothing of our shops, or for that matter of any shops, and have failed to avail ourselves of the intelligence that lay within our grasp in the brains of our workers."

Travesties Upon Real Taylor System

This is all too true. I did not know Mr. Taylor and never came in contact with his system as installed under his personal supervision, but it has been my disgusting privilege to visit shop after shop that was in the iron-bound grip of what I hope (for the sake of Mr. Taylor's memory) was a travesty upon the Taylor system, where on one occasion I might have seen three or four men striving laboriously under the guidance of a white-shirted and becollared youth to do in a given time what any one of them alone could have accomplished in less if they wanted to, or again an expert screw-machine hand would be making the fur—and oil—fly around his machine in a strenuous effort to beat the stop watch, and beating it beyond the wildest imaginings of the guy who held it, only the stop-watcher did not know the direction in which it was being beaten.

There have been during the past year or so of feverish industrial activity exhibitions of marvelous skill in some lines of work, and wonderful records for production have been established, and though many of them have been accorded due recognition in the newspapers doubtless a large majority will never be known beyond the immediate vicinity of their accomplishment; but there have been also many cases of mismanagement due to incompetence, crass ignorance or misapplied effort in which so-called scientific management should bear its full share of odium.

The theory of scientific management as evolved by Mr. Taylor was far from being altogether wrong, notwithstanding his unfortunate reference to a gorilla. It was, as I understand it, merely the application of mechanical principles to human endeavor, each member of the working unit having a definite duty to perform and a definite time allotted to its performance, so that the work of each would be done in proper relation to that of other units.

It was no more a part of his scheme that men should work to beat a stop watch than it is the intent of a good machine designer to make a certain cam perform its cycle of duty in the smallest fraction of time. Both cam and man must fit into the general design and work in harmony with what comes before as well as what follows after.

Scientific Managers Required

Scientific management presupposes a scientific manager, and it is right at this point that the system got its black eye. A machine designer must be thoroughly familiar with the materials and forces with which he seeks to accomplish a desired end. The scientific manager must be equally familiar with his materials and forces, and as these are human his is by far the more intricate study.

Now there are many would-be disciples of Mr. Taylor who, lacking his mental ability and analytical vision, see only the stop watch and the multiplicity of card records, charts, etc., as the whole conception, when as a matter of fact these are but the paraphernalia, the tools by which the more intangible human forces are correlated. In too many cases he is neither scientific nor a manager. He sees the human element as so many tools that according to previous records are capable of performing certain tasks, and he remains indifferent to, because ignorant of, the thousand-and-one conditions that affect its productive capacity.

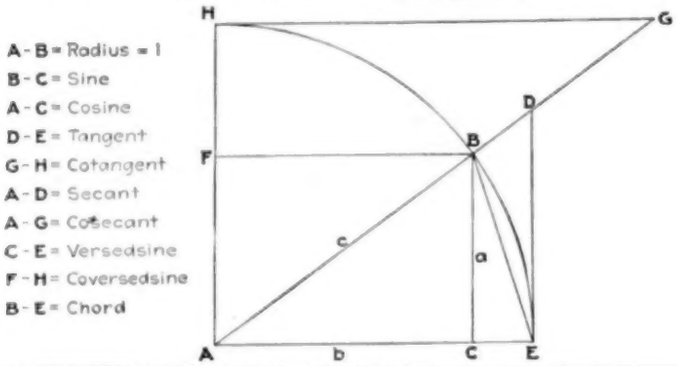
The manager who treats his "help" with the consideration due to fellow beings; who appeals to their sympathies and enlists their coöperation; who by virtue of common sense, fair and just dealing and knowledge of his business is able to *lead* a body of men who admire and respect him, will be the scientific manager of the future, while the fellow who, knowing a great deal about plotting and figuring percentages, a little (sometimes very little) about shops and shop methods, and nothing at all of human nature, seeks to *drive* with the lash of "scientific management" a body of men who despise and ridicule him, will take a much-needed vacation —much needed by those whose efforts he sought vainly to direct.

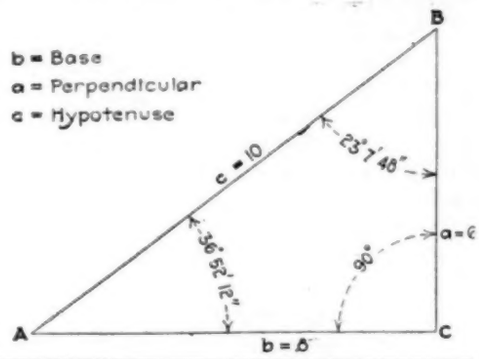
Simple Solution of Right-Angle-Triangle Problems for Mechanics

By S. A. Hand
Associate Editor American Machinist

Time was when trigonometry in the machine shop was unknown, but in recent years, and especially since the sine bar has come into almost universal use, it has become necessary for toolmakers and machinists to know how to figure problems involving the right-angle triangle.

While the formulas given in the handbooks seem simple enough to those who have studied trigonometry,





To Find	Knowing	Rule	Formula	Example
Angle A	Angles B and C	Subtract angle B from angle C	$C - B = A$	$90° - 53° 7' 48'' = 36° 52' 12''$
Angle B	Angles A and C	Subtract angle A from angle C	$C - A = B$	$90° - 36° 52' 12'' = 53° 7' 48''$
Angle C	Angles A and B	Add angle A to angle B	$A + B = C$	$36° 52' 12'' + 53° 7' 48'' = 90°$
Sine A	Sides a and c	Divide side a by side c	$\frac{a}{c} = \sin A$	$\frac{6}{10} = 0.60000 = \sin 36° 52' 12''$
	Cosecant A	Divide 1 by cosecant A	$\frac{1}{\text{cosec } A} = \sin A$	$\frac{1}{1.66666} = 0.60000 = \sin 36° 52' 12''$
	Tangent A and cosine A	Multiply tangent A by cosine A	$\tan A \times \cos A = \sin A$	$0.75000 \times 0.80000 = 0.60000 = \sin 36° 52' 12''$
	Tangent A and secant A	Divide tangent A by secant A	$\frac{\text{Tan } A}{\text{sec } A} = \sin A$	$\frac{0.75000}{1.25000} = 0.60000 = \sin 36° 52' 12''$
	Cosine A and cotangent A	Divide cosine A by cotangent A	$\frac{\text{Cos } A}{\text{cot } A} = \sin A$	$\frac{0.80000}{1.33333} = 0.60000 = \sin 36° 52' 12''$
	Cosine A	Subtract the square of cosine A from 1 and extract the square root of the remainder	$\sqrt{1 - \cos A^2} = \sin A$	$\sqrt{0.36} = 0.60000 = \sin 36° 52' 12''$
Cosine A	Sides b and c	Divide side b by side c	$\frac{b}{c} = \cos A$	$\frac{8}{10} = 0.80000 = \cos 36° 52' 12''$
	Secant A	Divide 1 by secant A	$\frac{1}{\text{sec } A} = \cos A$	$\frac{1}{1.25000} = 0.80000 = \cos 36° 52' 12''$
	Cotangent A and sine A	Multiply cotangent A by sine A	$\text{Cot } A \times \sin A = \cos A$	$1.33333 \times 0.60000 = 0.80000 = \cos 36° 52' 12''$
	Sine A and tangent A	Divide sine A by tangent A	$\frac{\text{Sin } A}{\tan A} = \cos A$	$\frac{0.60000}{0.75000} = 0.80000 = \cos 36° 52' 12''$
	Cotangent A and cosecant A	Divide cotangent A by cosecant A	$\frac{\text{Cot } A}{\text{cosec } A} = \cos A$	$\frac{1.33333}{1.66666} = 0.80000 = \cos 36° 52' 12''$
	Sine A	Subtract the square of sine A from 1 and extract the square root of the remainder	$\sqrt{1 - \sin A^2} = \cos A$	$\sqrt{0.64} = 0.80000 = \cos 36° 52' 12''$
Tangent A	Sides a and b	Divide side a by side b	$\frac{a}{b} = \tan A$	$\frac{6}{8} = 0.75000 = \tan 36° 52' 12''$
	Cotangent A	Divide 1 by cotangent A	$\frac{1}{\text{cot } A} = \tan A$	$\frac{1}{1.33333} = 0.75000 = \tan 36° 52' 12''$
	Secant A and sine A	Multiply secant A by sine A	$\text{Sec } A \times \sin A = \tan A$	$1.25000 \times 0.60000 = 0.75000 = \tan 36° 52' 12''$
	Sine A and cosine A	Divide sine A by cosine A	$\frac{\text{Sin } A}{\cos A} = \tan A$	$\frac{0.60000}{0.80000} = 0.75000 = \tan 36° 52' 12''$
	Secant A and cosecant A	Divide secant A by cosecant A	$\frac{\text{Sec } A}{\text{cosec } A} = \tan A$	$\frac{1.25000}{1.66666} = 0.75000 = \tan 36° 52' 12''$
	Secant A	Subtract 1 from the square of secant A and extract the square root of the remainder	$\sqrt{\text{Sec } A^2 - 1} = \tan A$	$\sqrt{0.5625} = 0.75000 = \tan 36° 52' 12''$
Cotangent A	Sides b and a	Divide side b by side a	$\frac{b}{a} = \cot A$	$\frac{8}{6} = 1.33333 = \cot 36° 52' 12''$

To Find	Knowing	Rule	Formula	Example
Cotangent A	Tangent A	Divide 1 by tangent A	$\frac{1}{\tan A} = \cot A$	$\frac{1}{0.75000} = 1.33333 = \cot 36° 52' 12''$
	Cosecant A and cosine A	Multiply cosecant A by cosine A	$\text{Cosec } A \times \cos A = \cot A$	$1.66666 \times 0.80000 = 1.33333 = \cot 36° 52' 12''$
	Cosine A and sine A	Divide cosine A by sine A	$\frac{\text{Cos } A}{\sin A} = \cot A$	$\frac{0.80000}{0.60000} = 1.33333 = \cot 36° 52' 12''$
	Cosecant A and secant A	Divide cosecant A by secant A	$\frac{\text{Cosec } A}{\sec A} = \cot A$	$\frac{1.66666}{1.25000} = 1.33333 = \cot 36° 52' 12''$
	Cosecant A	Subtract 1 from the square of cosecant A and extract the square root of the remainder	$\sqrt{\text{Cosec } A^2 - 1} = \cot A$	$\sqrt{1.77777} = 1.33333 = \cot 36° 52' 12''$
Secant A	Sides c and b	Divide side c by side b	$\frac{c}{b} = \sec A$	$\frac{10}{8} = 1.25000 = \sec 36° 52' 12''$
	Cosine A	Divide 1 by cosine A	$\frac{1}{\cos A} = \sec A$	$\frac{1}{0.80000} = 1.25000 = \sec 36° 52' 12''$
	Cosecant A and tangent A	Multiply cosecant A by tangent A	$\text{Cosecant } A \times \tan A = \sec A$	$1.66666 \times 0.75000 = 1.25000 = \sec 36° 52' 12''$
	Tangent A and sine A	Divide tangent A by sine A	$\frac{\text{Tan } A}{\sin A} = \sec A$	$\frac{0.75000}{0.60000} = 1.25000 = \sec 36° 52' 12''$
	Cosecant A and cotangent A	Divide cosecant A by cotangent A	$\frac{\text{Cosec } A}{\cot A} = \sec A$	$\frac{1.66666}{1.33333} = 1.25000 = \sec 36° 52' 12''$
	Tangent A	Add 1 to the square of tangent A and extract the square root of the sum	$\sqrt{\text{Tan } A^2 + 1} = \sec A$	$\sqrt{1.5625} = 1.25000 = \sec 36° 52' 12''$
Cosecant A	Sides c and a	Divide side c by side a	$\frac{c}{a} = \text{cosec } A$	$\frac{10}{6} = 1.66666 = \text{cosec } 36° 52' 12''$
	Sine A	Divide 1 by sine A	$\frac{1}{0.60000} = \text{cosec } A$	$\frac{1}{0.60000} = 1.66666 = \text{cosec } 36° 52' 12''$
	Secant A and cotangent A	Multiply secant A by cotangent A	$\text{Sec } A \times \cot A = \text{cosec } A$	$1.25000 \times 1.33333 = 1.66666 = \text{cosec } 36° 52' 12''$
	Secant A and tangent A	Divide secant A by tangent A	$\frac{\text{Sec } A}{\tan A} = \text{cosec } A$	$\frac{1.25000}{0.75000} = 1.66666 = \text{cosec } 36° 52' 12''$
	Cotangent A and cosine A	Divide cotangent A by cosine A	$\frac{\text{Cot } A}{\cos A} = \text{cosec } A$	$\frac{1.33333}{0.80000} = 1.66666 = \text{cosec } 36° 52' 12''$
	Cotangent A	Add 1 to the square of cotangent A and extract the square root of the sum	$\sqrt{\text{Cot } A^2 + 1} = \text{cosec } A$	$\sqrt{2.77777} = 1.66666 = \text{cosec } 36° 52' 12''$
Versed sine A	Sides c and b	Subtract side b from side c and divide the remainder by side c	$\frac{c - b}{c} = \text{versin } A$	$\frac{2}{10} = 0.20000 = \text{versin } 36° 52' 12''$
	Cosine A	Subtract cosine A from 1	$1 - \cos A = \text{versin } A$	$1 - 0.80000 = 0.20000 = \text{versin } 36° 52' 12''$
Coversed sine A	Sides c and a	Subtract side a from side c and divide the remainder by side c	$\frac{c - a}{c} = \text{covers } A$	$\frac{4}{10} = 0.40000 = \text{covers } 36° 52' 12''$
	Sine A	Subtract sin A from 1	$1 - \sin A$	$1 - 0.60000 = 0.40000 = \text{covers } 36° 52' 12''$
Chord A	Sine $\frac{1}{2}$ A	Multiply the sine of half the angle A by 2 and by the radius or side c	$2c \sin \frac{A}{2} = \text{chord } A$	$\text{Sin } 18° 26' 6'' = 0.31623$ $0.31623 \times 2 \times 10 = 6.3246 = \text{chord } 36° 52' 12''$
Side a	Sides c and b	Subtract the square of side b from the square of side c and extract the square root of the remainder	$\sqrt{c^2 - b^2} = \text{side a}$	$\sqrt{36} = 6 = \text{side a}$
	Side c and sine A	Multiply side c by sine A	$c \times \sin A = \text{side a}$	$10 \times 0.60000 = 6 = \text{side a}$
	Side b and tangent A	Multiply side b by tangent A	$b \times \tan A = \text{side a}$	$8 \times 0.75000 = 6 = \text{side a}$
	Side b and cotangent A	Divide side b by cotangent A	$\frac{b}{\cot A} = \text{side a}$	$\frac{8}{1.33333} = 6 = \text{side a}$
	Side c and cosecant A	Divide side c by cosecant A	$\frac{c}{\text{cosec } A} = \text{side A}$	$\frac{10}{1.66666} = 6 = \text{side a}$
Side b	Sides c and a	Subtract the square of side a from the square c and extract the square root of the remainder	$\sqrt{c^2 - a^2} = \text{side b}$	$\sqrt{64} = 8 = \text{side b}$
	Side c and cosine A	Multiply side c by cosine A	$c \times \cos A = \text{side b}$	$10 \times 0.80000 = 8 = \text{side b}$
	Side a and cotangent A	Multiply side a by cotangent A	$a \times \cot A = \text{side b}$	$6 \times 1.33333 = 8 = \text{side b}$
	Side a and tangent A	Divide side a by tangent A	$\frac{a}{\tan A} = \text{side b}$	$\frac{6}{0.7500} = 8 = \text{side b}$
	Side c and secant A	Divide side c by secant A	$\frac{c}{\sec A} = \text{side b}$	$\frac{10}{1.25000} = 8 = \text{side b}$
Side c	Sides a and b	Add the square of side a to the square of side b and extract the square root of the sum	$\sqrt{a^2 + b^2} = \text{side c}$	$\sqrt{100} = 10 = \text{side c}$
	Side b and secant A	Multiply side b by secant A	$b \times \sec A = \text{side c}$	$8 \times 1.25000 = 10 = \text{side c}$
	Side a and cosecant A	Multiply side a by cosecant A	$a \times \text{cosec } A = \text{side c}$	$6 \times 1.66666 = 10 = \text{side c}$
	Side a and sine A	Divide side a by sine A	$\frac{a}{\sin A} = \text{side c}$	$\frac{6}{0.60000} = 10 = \text{side c}$
	Side b and cosine A	Divide side b by cosine A	$\frac{b}{\cos A} = \text{side c}$	$\frac{8}{0.80000} = 10 = \text{side c}$
	Sides c and b and versed sine A	Subtract side b from side c and divide the remainder by versed sine A	$\frac{c - b}{\text{vers } A} = \text{side c}$	$\frac{2}{0.20000} = 10 = \text{side c}$
	Sides c and a and coversed sine A	Subtract side a from side c and divide the remainder by coversed sine A	$\frac{c - a}{\text{covers } A} = \text{side c}$	$\frac{4}{0.40000} = 10 = \text{side c}$

many mechanics do not seem to understand them readily. To enable those who have a knowledge of arithmetic only to easily find the different dimensions of the right-angle triangle this table has been prepared.

The particular angle chosen for illustration was selected on account of the ease in which the dimensions of the sides could be found by simple arithmetic.

The beginner will of course understand that dimensions of the sides of the triangle can be any other than those given in the illustration but their proportions will remain constant for the same angle.

Outside Aid in Developing Ideas

By C. E. Shaffner

We often hear the remark that a man is too near his work to get proper mental perspective. This article discusses the value to the mechanic of the views of the outsider, and intimates where a source of such coöperation may be found.

Not long ago I heard a conversation between an oil salesman and the master mechanic of one of the largest paper mills of its kind in the country, which strikingly indicates just what coöperation from the outside may accomplish in solving mechanical problems. The master mechanic was protesting vigorously against any inquiry into the lubricating requirements of the factory because he said it was an interference into the affairs of the company which resulted only in waste of time. In the end the salesman with a little persistence learned that the factory was really having trouble with machine lubrication because through oversight an oil of insufficient consistency had been recommended.

I believe this to be but an isolated illustration of an antagonistic and unreasonable attitude which does not generally prevail among shopmen; nevertheless it points out a tendency to which all of us are liable. Thorough familiarity with certain methods of machining and constant work in manufacturing the same products cause machinists in some cases to ignore outside assistance just as manufacturers are often unwilling to have advertising men take up their merchandising problems because they feel these outsiders have but an inadequate knowledge of their business.

Most of us have learned that a new point of view usually results in helpful suggestions and not infrequently in a solution of mechanical problems which from within the shop are looked at too frequently from a limited range. There are some interesting sidelights on this matter of outside coöperation which indicate possibilities not thought of by machinists.

I have in mind a young foreman in a Detroit factory who is somewhat of a genius along certain lines of motor construction. By a rather unfortunate coincidence he is connected with a company engaged in an entirely different line of work, and is practically bound to this organization by family ties which mean a great deal for his financial future. One afternoon he was introduced by his superintendent to a sales engineer from a machinery firm, and as a result of a conversation that ensued he received guidance in the construction of an appliance for a tractor on which he had been working for a long time. This particular engineer happened to be in a position to give him specialized information because he had himself worked out the particular phase of the problem by the application of theories of which the young foreman had no knowledge.

Another mechanic I know of in a Philadelphia factory has obtained the help he needs in perfecting an electrical advertising machine through a chance meeting with a service man in his shop who was so interested in the idea that he readily got the assistance of electrical experts from his company. And I have just been told recently about a lathe hand who developed a particular interest in milling machines through an acquaintance with a service man sent out by the manufacturers, and because of knowledge gained in this way he was able to suggest an improvement, which has been adopted.

I appreciate the fact that hundreds of machinists never come in contact with engineers and service experts from outside companies, but I believe they can secure the assistance of such men in working out mechanical ideas. I have known men in the shop who have good ideas, yet take no steps toward their development simply because they believe they lack the necessary means. In the majority of these cases what they really need is information which easily becomes available when the proper sources are located.

The successful machine shop or factory has become too much of a clearing house for ideas to permit any of them to be idly passed by for the want of a little well directed coöperation. Engineers, salesmen and service men can do considerable missionary work in this respect in their contact with shop men, but their efforts are necessarily limited. There are channels of information open for all requirements, and they can be located with little difficulty by taking the matter up with any foreman or superintendent who is in a position to establish a point of contact with the proper parties.

Ancient Rustless Iron

According to a Dutch technical paper a smith who lived in the sixteenth century in the town of Edam, in North Holland, where the cheese comes from, knew a process of making iron rustless, and some of his handiwork is to be found in the town to this day, but he took the secret of the process of manufacture to his grave. The piece of rustless ironwork made by him which still survives consists of part of the iron railing of a bridge in Edam which was originally erected in the year 1569. In 1625 the old wooden bridge, of which the railing formed part, was replaced by a stone structure, and the railing was taken down. It was reërected, but some of the lengths were lost, and the others, which bore the date of their manufacture, were not replaced in their proper order, but mixed with lengths of ordinary iron, which is not rust free. The peculiarity of part of the railing being impervious to rust used to be pointed out as a curiosity to visitors; but about 20 years ago the town architect, who failed to appreciate the importance of the matter, had the whole railing painted green. Recently Edam was visited by two members of the Commission for the Preservation of National Monuments, who ordered that the railing is not to be repainted, and in due course it is expected that the iron will be restored to its original condition. It is surmised that the sixteenth-century smith, whose name has not been handed down, was himself ignorant of his "invention."—*Brass World.*

Labor Turnover and a Remedy

By W. H. WEINGAR

Labor turnover, always too great, has during the past few years reached the point where its magnitude, together with its cost and disorganizing effects, has driven employers almost frantic in their efforts to keep production up to the maximum. This article tells in detail how one large munition plant has successfully handled the problem.

THE unprecedented demand upon manufacturers of munitions and general war supplies up to the present time has meant nothing short of maximum production per man and per machine. No shop is working at 100 per cent. efficiency unless every machine is turning out work to its capacity, and there may be instances where shops may have each machine working full time and still not reach the 100 per cent. mark.

At first glance it would appear that the responsibility for maximum production lies with the employment department in that were there a sufficient number of men to keep the machines running there would be no cessation of production. In point of fact this is not true. In many plants there is a steady stream of employees pouring out at the same time the employment department is straining every effort to send others in to take their places.

The question of getting men is a comparatively easy one, but the real trouble—the one that comes closest to solving the problem of maximum production—is keeping them after getting them.

A careful analysis, by a large war-contract concern, covering many months' intensive study, shows the major causes for departures to be susceptible to correction. Friction aroused through the ill temper and intolerance of foremen, transportation difficulties and dissatisfaction over wages are a few of the matters that can be remedied within the shop. Dealing with an irate foreman requires firmness and tact. A foreman naturally is incapable of acting as judge and jury on his own case and the division superintendent will generally support his foreman's decisions. It is essential, therefore, to obtain the mediation of a totally disinterested third party to act as mediator between the employee and the executive.

To meet this situation, which was one of common occurrence, a dismissal interviewer was appointed, before whom every dismissal comes immediately, and no dismissed employee can get his pay unless his pay check is initialed by the dismissal interviewer. Good judgment, impartiality and patience are requisites for this work as its success depends more upon personality than almost any other work in the employment department. If the interviewer decides that the employee has been wronged he may send him back to his old department as a disciplinary measure. This has been so successful that at least in one case the foreman has called up the employment manager to express his appreciation in the face of his own bad judgment. Ordinarily it has been found advisable to place the employee in another department from the one he left.

DEPARTURE RECORD

DATE

NAME	DEPARTMENT	RATE	LENGTH OF SERVICE

1 2 3 4 5 6 7 8 9 10 11 12 13

RESIGNED ☐ OCCUPATION REASON FOR DISMISSAL

DISMISSED ☐

LAID OFF ☐

GENERAL FOREMAN

TRANSFER TO

DEPARTMENT

RATE

DATE

NEW FOREMAN

GENERAL FOREMAN

FOREMAN

INVESTIGATION BY

E. O.

ABOVE FOUND CORRECT

PAID OFF REINSTATED

FIG. 1. RECORD OF DEPARTURE

CLEARANCE SLIP

Employee's No. Date

Name

ARTICLE	CLEARED	CHARGE	
a) Tool Checks			
b) Tools			
c) Keys			
d) Spoiled Work			
e) Broken Gages			
f) Real Estate Dept.			
g) Meal Books			
h) Barracks Acc't			
i) Uniform "			
j) Badges			

INSTRUCTIONS FOR THIS FORM

Use for all departures, quit, laid off, discharged or transferred.
All spaces ***above*** the line on other side ***must*** be filled in by Foremen and approved by General Foreman.
White Copy to remain in Foreman's File.
In cases Discharged Yellow and Blue Copies to Employment Office.
In cases Transferred, Yellow to Paymaster, Blue to Emp. Office.

FIG. 2. CLEARANCE SLIP (ON BACK OF FIG. 1.)

A complete detailed report of the work done has been kept by the dismissal interviewer. The forms here shown were designed with respect to clarity and simplicity, so that the various summaries or resignations and dismissals, whether of skilled or unskilled, male or female, could be gained at a glance. Dismissals and resignations were listed under different heads, such as irregularity, incompetence, insubordination, dishonesty, sickness, better position, etc. This record form has been of inestimable value.

It is difficult to measure the results of so intangible a thing as morale, but besides retaining hundreds of valuable employees this method of dealing with departing employees has spread a feeling of loyalty and has reinforced the contact between the men and the management.

When we become satisfied that the turnover had been lowered as far as it could be our next task was to

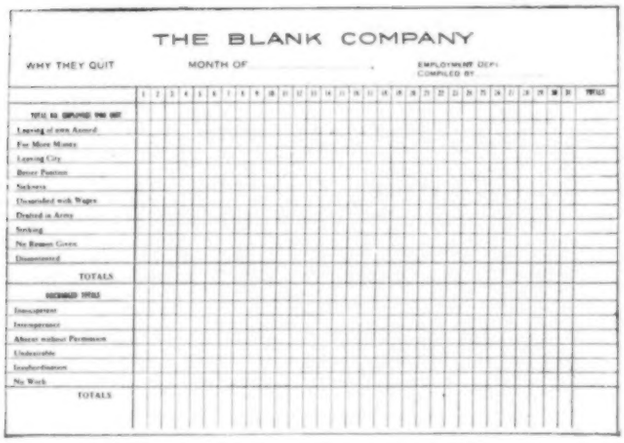


FIG. 3. DETAILED REPORT OF TURNOVER

improve the quality of the raw labor entering the plant. The standard of labor had depreciated greatly since the beginning of the war, and on account of the scarcity it was necessary to utilize men without training and of a type not generally used in factories—elderly men and dry-goods clerks, ministers and musicians and people of both sexes from every walk in life.

Formerly new employees were sent direct to the various production departments where they received the necessary instruction from the foremen and machine set-up men, but with the kind of labor we were receiving this practice could no longer be continued. The average inexperienced person has no conception of the dangers in operating machine tools; they do not realize the need of cleanliness in the event of receiving cuts and scratches, and the importance of one or two thousandths of an inch in the functioning of a machine gun, a fuse or other mechanical device means nothing to them. To instruct them thoroughly along these lines is beyond the capability of the ordinary foreman, so to help the new employee to obtain the best instruction that could be given, which was equally to the interest of the employer, an operators' training school was established.

This school was centrally located, readily permitting employees to be sent to the production shops, and it was also a convenience to superintendents and foremen who desired to be benefited from any practical suggestions it could impart.

The equipment of the training school is more ex-

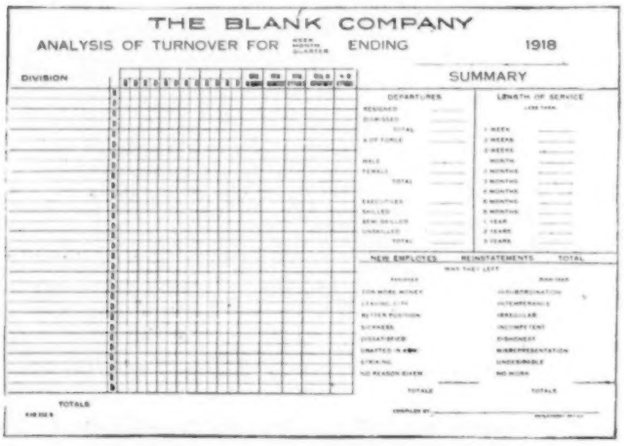


FIG. 4. ANALYSIS OF TURNOVER

tensive than that of almost any other school of its kind. This is largely due to the wide variety of machines used in the manufacture of machine guns and other small arms being produced in the plant of the Remington Arms Union Metallic Cartridge Co. Each type of machine set up in the factory is represented in the school, and only the most modern machinery is installed. There are cylindrical grinding, milling, screw, profiling and drilling machines, lathes and so on, and the pupils

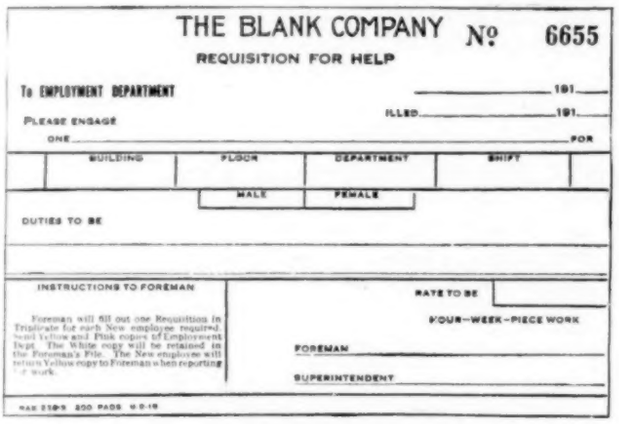


FIG. 5. REQUISITION FOR HELP

are instructed on these types with specialized training on one before they are sent into the shops.

At the head of the school is a man of wide experience and education. He is in charge of the apprentice school as well, and under him is a large and carefully chosen corps of assistants. These men have not only mechanical ability but the power of imparting the knowledge they possess.

Before the new employees are put on machines they are gathered into the lecture room where they are given a talk on cleanliness, safety, opportunity and responsibility. An attempt is made to bring home to every newcomer a realization of his obligation to himself, his company and his country. The students are impressed that each one of them is vital to the organization and their patriotism is stimulated to the utmost.

Cost of Hiring and Training

The cost of hiring and training a new employee is shown to the students; their attention is called to their slowness in production and to the rapid progress they can make through intelligent and conscientious observance of their instructions. They are shown the small value of rapid, spasmodic production in comparison with continuous, average-speed work. In brief, every advantage that the school offers is seized upon to create the proper mental attitude toward the firm as well as to hammer home the truths that will be of incalculable advantage to the employee.

After leaving the school the progress of the student is followed up carefully, and weekly records of his work is kept in the school for months after his departure. In this way check can be kept on the results of the school's methods and any change for improvement offered.

The attention given to the progress of the student and the frequent visits he receives from members of the school faculty after he enters on production work in the plant impress upon him that he is more than a

number or a name on the payroll. We try to convince each member of the organization that his efforts are appreciated, and when representatives of the school or of the executive offices stop to say good morning to him at his machine he realizes that we are watching him and trying to keep in touch with him for his own benefit. This particular method has resulted in a better feeling toward the company on the part of beginners than if the man were let alone after starting work and allowed to drift back into the usual apathetic frame of mind so common in factories.

We have tried to convey to the employees that if discharged they will be given a sympathetic hearing by the dismissal man at the employment office. Unfortunately foremen are not always 100 per cent. loyal or efficient, and if an employee feels that his foreman is a little bit rough on him he can tell his story to the dismissal interviewer even though he may not have been discharged. If several apparently unreasonable discharges have occurred in one department the dismissal interviewer conducts a little quiet investigation, and where conditions appear to be radically wrong steps are taken to correct them.

The spread of the feeling throughout the shop that every employee is sure of an absolutely square deal creates an ease of mind on the part of the men that is beneficial. The knowledge of this same fact is also advantageous to the company because of its effect upon the conduct of the foremen. The foremen realize that the petty squabbles and imaginary injustices they have heretofore had to iron out themselves will be taken care of by the dismissal interviewer, and when they know that a summary discharge for little or no reason will be promptly voided at the employment office they think twice before releasing an employee.

A large number of the discharges in the average plant are due to the impatience or personal feelings of the foremen, but since installing this method of investigating discharges there has been a marked decrease in the labor-turnover figures attributed to discharges. The method has also had a good effect in reducing the percentage of resignations.

Disability Under the Compensation Acts—II

By CHESLA C. SHERLOCK

Under the laws of some states partial loss of vision or hearing is not compensable and the workman can only collect for temporary disability which ends when he returns to work. In many cases this is manifestly unfair and a moral liability should direct the employer where the legal liability is nonexistent. In making awards the courts usually rule that loss of earning power is not the controlling factor in cases of permanent partial or total disability.

PARTIAL disability as it is known under the compensation acts is more properly designated as permanent partial disability. These injuries are most generally specifically enumerated by the statute itself, which also allows a specific recovery for the particular disability.

Under the discussion concerning temporary disability we found that if a man is injured so that he is unable to carry on his work for a short time he is suffering from technical temporary disability. He is totally incapacitated, being unable to work for a temporary period.

If his injuries are such that he can never be restored, although he may in fact recover his former earning power in his particular employment, he is said to have suffered a permanent partial disability. An example of such an injury is the loss of a finger, a hand or an arm. The workman's earning power may be restored to him within a short time, but the character of his injuries is permanent in nature. It is this class of injuries which is designated by the compensation acts as partial disability.

Inasmuch as many of the statutes classify these injuries under a schedule showing the amount of compensation payable for each specific injury they are often called "schedule injuries," although this term is confusing and improper.

The statute itself is the authority under which settlements are made for partial-disability cases. It is not expedient to treat of those common partial-disability cases which are plainly treated in the respective statutes, as there is no room for argument or doubt where the legislative intent has been clearly expressed. If the statute allows 40 weeks' compensation for the loss of a thumb there is no alternative for the employer but to pay that amount.

It is well to observe, however, that a workman suffering from a disability of this nature, the loss of a member or of any other schedule injury, is entitled to the full amount of the compensation awarded by the statute regardless of whether his actual earning power has been affected or not. If the workman returns to work within two weeks the employer cannot pay him two weeks' compensation and call it square. He must continue the payments for the full statutory period regardless of the status of the workman's present earning power. The law deems that the workman's efficiency has been impaired to the extent mentioned, and there is no showing on the part of the employer which will overcome this presumption.

Cases Where the Law Is Silent

The room for real doubt arises in cases where the law is silent and does not mention the amount of compensation which is to be paid for a given injury. A good example may be cited from many of the states, particularly Connecticut, Iowa and others, where no allowance is made for the partial loss of vision. Most of the statutes contain provisions compensating a workman for the loss of one or both eyes, but they have overlooked instances where only a partial loss of vision is sustained.

Naturally the question arises as to the right of these unfortunate workmen to have more compensation than

they would receive if they suffered merely from temporary disability. Temporary disability, as we have noted before, ends when the workman returns to work.

If these men return to work when they have recovered from the shock of the accident they can no longer draw compensation for temporary disability. They have not lost an eye or both eyes; therefore can they receive such compensation when they have not suffered the loss compensated by the statute?

Legislation Intent

It is contended with very good reason that it was the legislative intent to award compensation to all who have suffered partial disability without reference to their loss of earning power, and for authority the workman points out the fact that the man who loses a finger is compensated as well as the man who loses a hand, regardless of whether such loss affected his earning power or not.

Unfortunate as it may seem there is no legal duty devolving upon employers to pay compensation for a partial loss of vision where the statute is silent upon the subject. Where the legislature has not expressed an intent, although there is every reason to believe that such an intent existed, there is no recourse but for the workman to accept the compensation which the law has specifically conferred upon him, namely, compensation for temporary disability.

These instances have come up in many of the states where the laws were the "product of the shears rather than of the pen," but it is safe to say that as soon as the respective legislatures have the opportunity they will remedy the situation by fixing a schedule of compensation for those who lose a portion of their normal vision.

The same thing can be said of a partial loss of hearing. A workman suffers the loss of hearing completely and he is compensated, but if he suffers only a partial loss he can receive only the compensation granted for his temporary disability.

Loss of Teeth

It is a praiseworthy act on the part of the majority of employers when they pay the workman so injured a percentage of the compensation based on total loss of sight or hearing, as the case may be, without regard to their legal liability to do so. I am familiar with many instances of this nature, and it cannot reflect too highly to the credit of these public-spirited employers. Whether the legal liability is present or not the moral liability is there, and they are allowed to escape legally only because of an oversight on the part of the legislative authority.

The loss of teeth is a common instance where the legislature has been entirely silent on partial-disability cases. The number of instances in which workmen have some or all of their teeth knocked out is by no means a freak occurrence at the present time. It is especially noticeable in cases where workmen are employed on machinery or in the transportation of raw materials.

I do not recall a single original compensation act which allowed compensation for the loss of teeth. The law imposes on the employer the duty of providing medical, surgical and hospital aid within certain limitation to all employees who are in need of them, in addition to the compensation benefits mentioned under the acts, but seldom, if ever, is reference made to dental benefits.

The workman who suffers a loss of teeth is entitled to aid just as much as the man who loses a finger or a toe. In fact it would seem that he is more entitled to aid in this case because there is nothing that so completely disables a man or impairs his health and efficiency as does the loss of his teeth. It is worth noting that the states are quickly amending their acts in this respect. In Iowa the matter will be before the legislature this spring, and it will also come up in other states.

Graduated Compensation

Many of the states have a provision in the compensation acts which stipulates that in case a workman suffers a partial disability and no scheduled amount of compensation is mentioned in the act for such disability the compensation shall be based upon the amount allowed for permanent disability.

Thus in Minnesota a workman sustained a 10 per cent. loss of vision. The statute allowed 100 weeks' compensation for the loss of an eye, so the court held that the compensation should be based on the amount allowed for the loss of the whole vision, to be determined by medical opinion.

But if in the permanent disability schedule no mention is made of the specific injury the workman can recover nothing but compensation for his temporary disability.

If a workman draws compensation on an injury and later the injury causes total loss of the member the question arises as to whether he is entitled to full compensation for his complete loss of member or whether the compensation already paid must be deducted from the amount allowed for the full loss.

A case of this nature might be illustrated as follows: A workman suffers a partial loss of vision, which is determined by medical experts to be 40 per cent. loss of vision. The law allows the workman 50 per cent. of his average wages for 100 weeks for the total loss of vision. The award is accordingly made for 40 weeks' compensation. Subsequently the injury causes the workman to sustain a complete loss of vision. The question arises, Is he entitled to 100 weeks' additional compensation or the difference between 100 and 40, the amount already paid, which is 60 weeks? The courts and commissions are almost unanimous in holding to the latter view that the workman can recover no more than the schedule amount regardless of how long his injury was prolonged.

This same situation arises between temporary and partial disability and between temporary and permanent disability as was shown above between partial and permanent disability. If the workman has been paid compensation for a period covering his temporary disability he cannot recover the full amount awarded for his partial disability or permanent disability, as the case may be, unless the law specifically grants it to him. Some of the states have expressly declared that if a workman sustains such an injury as entitles him to relief under the schedules such compensation paid for temporary disability shall not be deducted from the schedule amount.

Other states accomplish the same result in the end by increasing the percentage of the workman's wages which the employer shall pay for injuries, but allowing the law to stand as it was before, so far as deducting the compensation paid for temporary disability is concerned.

In determining the amount of compensation which is due for a partial disability it should be kept in mind that the court, where given authority by the statute, must fix the compensation on the amount awarded in such case if a permanent total loss had been sustained. Suppose, for instance, that a workman loses a hand, the law remaining silent so far as the loss of a hand is concerned, but allowing 250 weeks' compensation for the loss of an arm and 175 weeks for the loss of the arm at the elbow.

The workman may show that the loss of his hand was worth in proportion to him, so far as the loss of the whole arm was concerned, 200 weks' compensation. But such an award cannot legally be made, because the law specifically limits his compensation to 175 weeks for the loss of the arm at the elbow. He cannot have greater compensation for a lesser injury.

Loss of Little Finger

This principle holds true all through the subject of partial disability. The compensation awarded for a lesser injury than that mentioned by the statutes cannot be out of proportion to the compensation granted for the greater injury. If a workman loses a little finger and the law allows 50 weeks for the thumb he cannot receive 50 weeks' compensation for the loss of the little finger.

Some of the states arrive at the amount of compensation due the workman for partial disability in an entirely different manner. They proceed on what is known as the system of proportional, or estimated, awards. This is a much more scientific way of taking care of workmen than the arbitrary schedule system.

The system might be roughly illustrated by saying that each workman is given an efficiency standard and his earning capacity based according to the standard to which he belongs. If he loses a hand that loss impairs his efficiency just so much and he is compensated according to his loss. In the instance of one man the loss to the workman may be slight. Such a system is correspondingly beneficial to the employer. If the man was of a high standard and his injury played a great figure in his ability to do future work his percentage of loss was determined and payment made accordingly. His compensation might be several times that granted to another man for the same injury. This is the theory of the system, but it has not been applied in just this manner.

Ordinarily, workmen are said to have a certain standard and their partial disability bears a certain percentage to their full earning power. It then follows that in the average application of the system sooner or later the tendency is to fall back into cut-and-dried schedules granting so much compensation for such and such injury, so that in the end the system has slight advantage over statutory schedules.

The schedules granting compensation for partial disability are not the arbitrary word of the legislature as to the value of certain specific losses, as so many employers and workmen are prone to believe. These schedules have been arrived at only after the most exhaustive research of actuarial statistics and are for the most part entirely adequate and fair. The great difficulty is that so far as individual workmen are concerned they often work hardship. They overcompensate some and undercompensate others. But no system of jurisprudence has yet been devised which is perfect in its application to humanity at large and to individuals in particular. The hope and the purpose of the law is to perform the ends of justice at all times.

Two Typical Cases

Some of the statutes contain no schedules for partial disability cases, but provide compensation on a certain percentage of the wages extending over a period of years. A noteworthy example is Kansas, where the period of years is eight, no reference being made to the actual wage loss. This system is in effect nothing short of a pension system, for no reference is made to the workman's value in industry, but upon injury he becomes entitled to full benefits, regardless of whether it over or under compensates him.

In this state it was found that a certain workman had suffered a partial disability, but that he had resumed his employment at his former wages. The employer contended that there was no necessity for the continuance of the compensation as the earning power had been restored. The court, however, held that such was not the case; that the employer must continue the payment of compensation and that his liability under the law did not end with the return of the workman to his employment unless such employment was to continue for the period of eight years.

The court further pointed out that at some later date before the expiration of the statutory period the workman might want to leave the old employment and seek work elsewhere, at which time the permanent partial disability might seriously affect his earning power. The ruling here is in line with the ruling elsewhere to the effect that loss of earning power is not the controlling factor in permanent partial or permanent total disability cases.

Where a workman suffers a permanent partial disability it is not necessary that he suffer the complete severance of the member in order to recover his compensation. The acts were enacted in a "spirit of true helpfulness" and they are generally construed in that manner. For all general purposes the loss of use of the members will suffice, amounting to the same thing as amputation or total loss.

If a workman loses several members, which in turn cause him to lose the use of a greater member, the courts will generally award him compensation for the loss of the greater member. This is particularly true in cases involving injuries to the hands. It is commonly acknowledged that the hand is useless without the fingers. If the fingers have been severed, or enough of them to render the hand useless, even though the palm remains, it is generally held that the workman is entitled to compensation for the loss of a hand.

An Illinois case is frequently cited as an example of this view. A workman lost all of his fingers with the exception of the thumb. He was awarded compensation for the loss of the hand because the court declared that

for all practical purposes he might just as well have had the hand severed at the wrist as to have lost all four fingers.

Loss of use is the controlling factor in these partial-disability cases. All of the fingers may be intact on the hand, but they may be so badly used up that they are useless to the workman. In that case, if he has lost the use of his hand, he will be compensated accordingly, even though he still has his hand.

However, there is this caution to observe. The loss of use must be permanent, at least is the opinion of competent medical testimony. No such reward will obtain or should obtain where there is a probability that there will ever be a recovery of the use. In the case of amputation such a recovery is of course removed, but it is always more or less present where the members are still attached to the body. But cases are plentiful where this reasoning is applied, provided it is sustained by the most competent medical testimony at hand.

It has been held in both New York and Vermont that where a partial disability is sustained and compensation awarded according to the schedule contained in the law that that is all the compensation allowable and that the workman cannot later receive more compensation from his employer for subsequent loss of earning power due to the injury.

One injury may in its nature so affect other portions of the workman's body or member as to render them practically useless. This is shown in a case where the loss of one joint of a finger so stiffened the other joints of the finger that the finger was worthless. The reward will generally be for the loss of the finger, but in no instance will it extend further.

Employment of Medical Treatment

Where proper medical treatment will, under ordinary circumstances, cure a case of partial disability and practically restore the workman to his normal usefulness it is the opinion of the authorities that the workman must submit to such treatment. The same can be said if the treatment will lessen the employer's liability under the law for compensation, provided it does not endanger the workman's life.

The law will not compel any man to undergo an operation or treatment which endangers his life or penalize him if he fails to take advantage of it, but in cases where there is no reasonable danger the workman must submit or suffer his compensation payments being reduced.

Suppose that a workman has sustained an injury to his knee so that it is stiff and he is unable to use his leg to any great extent. His injury may even be so pronounced that he has practically lost the entire usefulness of the leg. But under competent and skilled medical attention the leg might be restored to its normal usefulness.

If the workman refuses to accept such treatment or operation his compensation will be fixed at the period of time up to the probable operation and the length of time which it would ordinarily take thereafter for him to normally recover from the operation. The employer is of course liable for the payment of such medical treatment or operation if it is undertaken with the view of lessening his own compensation liability.

If the workman accepts the treatment and undergoes the operation, but it is unsuccessful and leaves him in worse shape than before, then he is entitled to compensation for full loss of the member. If the operation is succesful he has really gained a great deal because he has his leg back at no cost to him and he is paid compensation until he has had time to recover from the effects of the operation. This is one of the really beneficial things of the compensation practice.

I have known of instances where an agreement was entered into between the workman and the employer that the operation was to be made, but if the surgeon found that after cutting open the leg there would be practically no chance of restoring its usefulness he was to go ahead and amputate the leg and thus save the workman the inconvenience of its pain in the future. In this instance the employer took a chance of reducing his compensation liability, and that failing, removed the leg for the workman, doing the same without additional cost to himself and performing a lasting service to the workman.

The real difficulty in partial-disability cases is in determining the extent of the disability and in arriving at the measure of liability in instances where through the sins of omission the legislature has failed to provide protection for the workman. In either instance it is hoped that this discussion has served to clear up the matter of partial disability in the minds of employers, for it is a subject which is often very much misunderstood.

Daylight Saving

By Matthew Harris

The time table for daylight saving published on page 364 of the *American Machinist* reminds me that Chordal told us of such a table in one of his early letters published in the *American Machinist* on Nov. 29, 1879.

The table is here given, and according to Chordal was calculated by the late Charles A. Bauer, who was at the time superintendent of the Champion Bar and Knife Works, Springfield, Ohio.

TIME TABLE. AVERAGE 10 HOURS

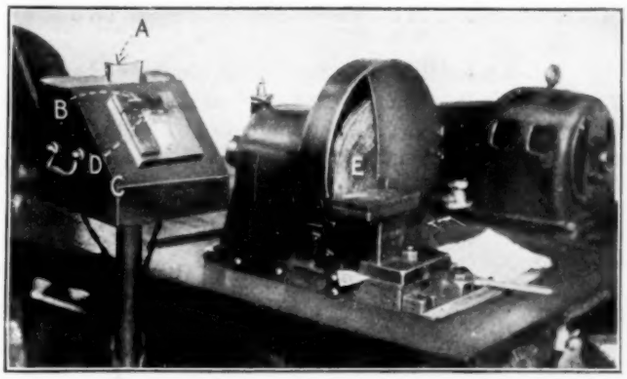
Date	Go to Work A.M.	Be Gone to Dinner	Go Home
Jan. 1	7.15	1 hour	5.00
Jan. 8	7.15	1 hour	5.15
Jan. 29	7.00	1 hour	5.30
Feb. 12	7.00	1 hour	5.45
Feb. 19	6.45	1 hour	6.00
Mar. 18	6.45	1 hour	6.15
Sept. 16	6.45	1 hour	6.00
Oct. 7	6.45	1 hour	5.45
Oct. 14	6.45	1 hour	5.30
Nov. 11	7.00	1 hour	5.15
Dec. 2	7.00	1 hour	5.00
Dec. 9	7.15	1 hour	5.00
Dec. 16	7.15	1 hour	4.50

Commenting on the subject Chordal said: "The pay of the men is never changed. They get 10 hours pay every day. There are vicious sides to this time-table plan when taken advantage of by unscrupulous men, both owners and workmen. I have heard workmen kicking against the plan because some roguish owner had paid them wages during the summer and then put them on starvation piece work in the winter, and I have seen owners the victims of sharp workmen who drew wages during the winter and went to other shops in the summer. This table is a good gage for morals. In smooth-working shops I have seen men growling in summer over the long hours. These men were invariably big fools who knew nothing of the laws of compensation or the rules of average."

Device for Gaging Chaser Blanks

By J. B. Smith

It is necessary that the blanks for chasers used in quick-opening die heads be square to within very close limits, especially with reference to the base and the end upon which the threads are to be cut. The method here illustrated is that employed in the plant of the Modern Tool Co., Erie, Penn.



GRINDING WHEEL AND GAGING DIVICE FOR CHASER BLANKS

A chaser blank is shown at *A* and the gaging device at *B*. This device is mounted on a box *C*, which incloses an incandescent lamp, the light from which shines through a narrow slot *D*.

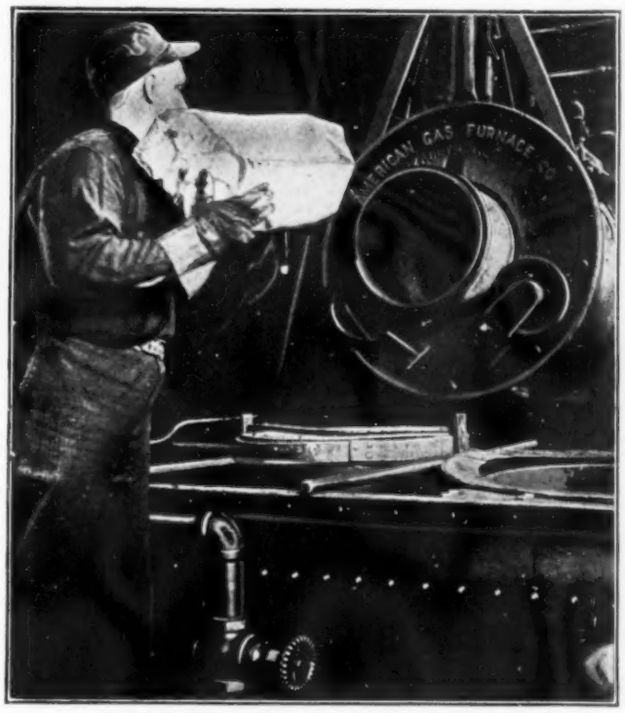
When the operator holds a blank against the gage the light shining through this slot shows very plainly any discrepancy in squareness of the two most essential edges, and the work may be more rapidly passed than by holding a standard square on the piece every time it was checked up.

The grinding of these is done on the small motor-driven disk grinding wheel *E*. Seated on a stool before this wheel the operator can rapidly grind the parts and check them on the gage until they have been finished correctly.

Carbonizing in a Rotary Furnace

By W. H. Addis

No, the man in the picture is not loading a giant trench mortar. He is a rotary-furnace operator snapped at his regular job of charging his furnace "somewhere in America," and he is loading his furnace with a large 50-lb.-sized paper bag containing 30 lb. of high-grade carbonizing compound. One 30-lb. bag of compound is sufficient to treat 130 lb. of work, which is loaded in like manner by placing in two bags of equal capacity. This ratio of work to compound is correct for the best commercial carbonizers, which are generally of uniform quality. The paper bag containers burn up in the retort, releasing their contents which are mixed by the tumbling action of the rotating retort.



A ROTARY CARBONIZING FURNACE

The change from the packed-pot, oven-fired type of furnace to the bag-loaded rotary made itself first felt in our packing room where a large force of girls who once packed pots were released for other work. A few hours each day is sufficient time for one man to fill and weigh enough paper bags for a battery of rotary furnaces. Then there is the advantage of knowing with certainty the correct ratio of work to compound and to be able to control it.

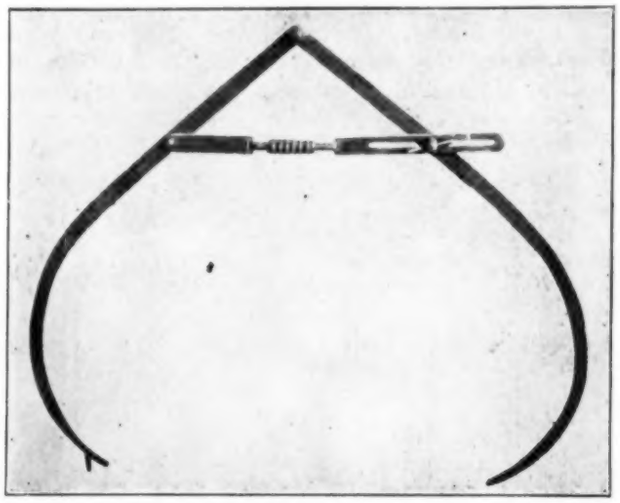
Production is greatly increased over the oven type of furnace. This may be attributed to the fact that the rotary retort does not have to be raised to carbonizing heat, as do the pots, for it is right at that temperature when the paper bags are put in. It is also true that there is immediate contact of the work with the retort just as soon as the bags burn. There is for

this reason a big reduction of heating time over the best type of oven furnace. In other methods each pound of work took its pound of compound, but here a remarkable saving is made due to the fact that there is very little loss of gases through the sealing of the rotary retort, while with other methods there is always the loss of gases from each pot in the furnace. This loss has been computed by well-informed men to be at least 20 per cent.

A Large-Sized Caliper With Turnbuckle Adjustment

By J. Wright

A large-sized outside caliper with a capacity of about 60 in. span has been made in the Wilson Ave. shops of the Northwestern Elevated Railway System of Chicago.



LARGE OUTSIDE CALIPER

The unique feature of this caliper is that for accurate adjustment it is provided with a turnbuckle in the center of its clamping bar, the details being plainly shown in the illustration.

Bees' Wax Vise for the Miller

By E. A. Dixie

Vises have been shown in the *American Machinist* for holding a number of pieces at a time. Many of them employ levers, most of them are somewhat complicated and liable to get out of order, and all of them are somewhat expensive to make. Where levers are employed the mechanism is greatly simplified by having the numbers of pieces to be gripped a power of 2, as 2, 4, 8, 16, so that by a series of simple levers pivoted at their centers the reaction on the lever arms will be equal, as shown in Figs. 1 and 2. Where the number of pieces to be gripped is either odd or divisible by 3, as 3, 6, 9, 12, the levers must be of two kinds, some with equal arms and some with unequal arms, as shown in Fig. 3, to equalize the pressures on the work. This complicates the mechanism and multiplies the difficulties of producing an efficient vise.

Multiple-cylinder hydraulic vises using water, oil or alcohol are efficient for this work, but as a usual thing expensive to make. The work on them must be fairly accurate and the packing on the hydraulic rams in good order or the fluid will leak and render them inoperative. In Figs. 4 and 5 is shown a hydraulic vise devised by Mr. Emrick of the Eastern Tube and Tool Co.,

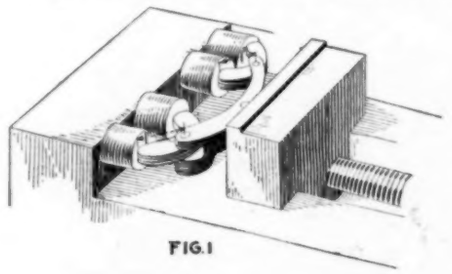


FIG. 1

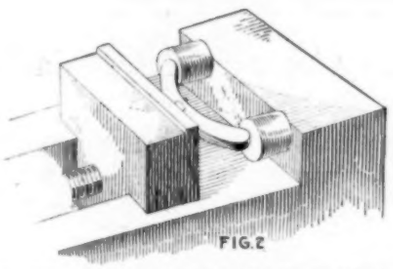
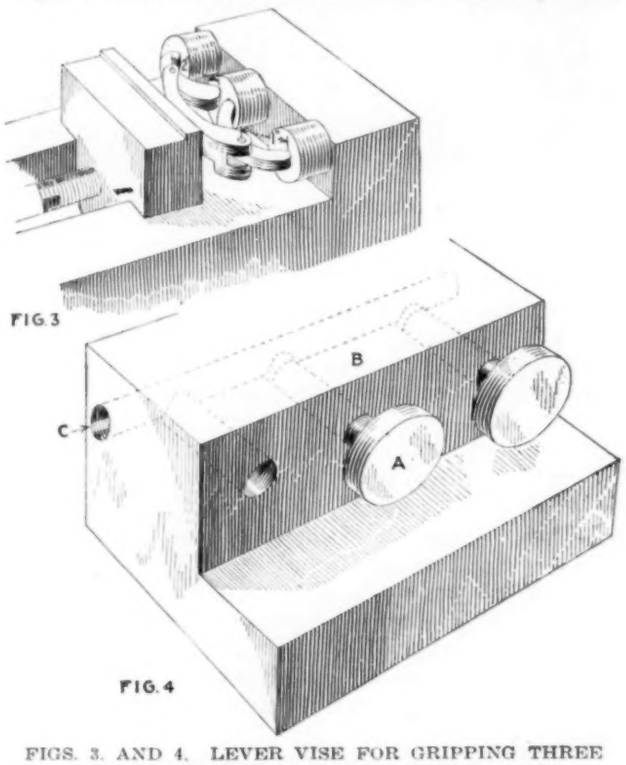


FIG. 2

FIGS. 1 AND 2. LEVER VISES FOR GRIPPING TWO AND FOUR PIECES OF WORK

Brooklyn, for holding any number of pieces, either odd or even. The parts are simple to make and no great accuracy is necessary. The plungers *A* are without packing, as none is necessary, because the medium used in place of water, oil or alcohol is ordinary bees' wax;



FIGS. 3. AND 4. LEVER VISE FOR GRIPPING THREE PIECES AND WAX VISE FOR GRIPPING ANY NUMBER OF PIECES

the member *B* is cast iron; the holes for the plungers *A* are drilled and reamed. A cross-hole that breaks into the rear ends of the holes for the plungers is drilled at *C*, but it does not go through the opposite side. The hole *C* need not be reamed, as it is merely a duct through which the wax passes as it equalizes the pressure on the various plungers.

With the parts *A* fitted to *B* and the hole *C* drilled the parts are assembled and the whole warmed so that it will not chill the wax.

When ready to pour the melted wax the plungers are pulled part way out, and with the hole *C* on top and the assembly tilted so no air pockets are formed the

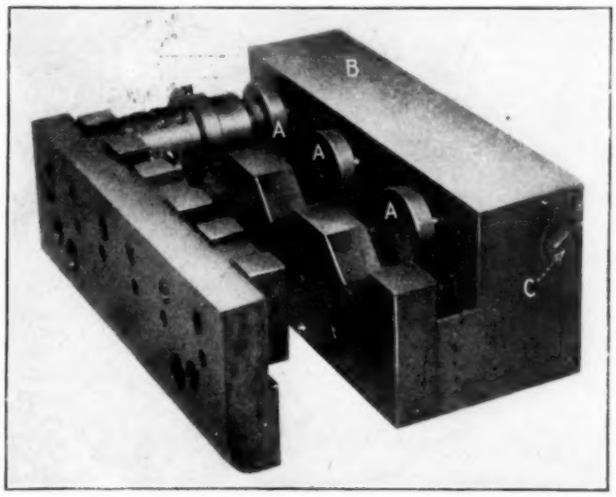


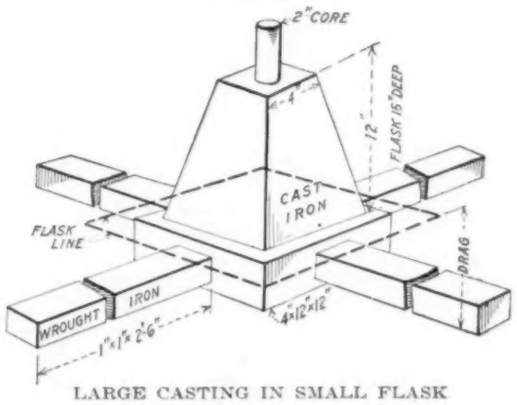
FIG. 5. THE WAX VISE COMPLETE

hot wax is run in clear to the top of the hole. When the wax is cold an ordinary pipe plug is screwed into the threaded end of the hole *C*. Under working conditions it will be found that the wax in time decreases in bulk and more will have to be added from time to time. When this becomes necessary the jaw assembly is warmed, the plug removed and more wax poured in.

Molding a Large Casting in a Small Flask

BY M. E. DUGGAN

A machine part the center of which was of cast iron with four wrought-iron arms cast in it was wanted in a hurry. The molder asked for the over-all dimensions of the patterns so that he might get out a flask suitable for the job, and the patternmaker, thinking that the



LARGE CASTING IN SMALL FLASK

pattern and iron arms would be molded within the flask, gave him the dimensions over the arms. When the pattern reached the foundry and the molder had given it the "once over," this is how it was molded: The pattern was imbedded in the floor of the foundry flush with the top of the arms. A flask 14 x 14 in. was used for the cope. The cope was made and lifted and the pattern withdrawn. The wrought-iron arms were then placed in position in the mold on the foundry floor and the cope put back in place, leaving the four wrought-iron arms exposed beyond the single-cope flask. Thus the piece was molded in a 14 x 14-in. flask and not in one about 6 ft. square as the patternmaker thought it would be.

Improved Micrometer Dial

BY A. ALLINGER

The sketch shows a micrometer dial which is very useful on the cross-feed screws of lathes, the traverse screws of milling machines or other places where a minute, definite movement is required and where it is of advantage to be able to make such movement quickly and accurately without the necessity of taking the eyes off the work.

MICROMETER DIAL WITH SPRING DETENT

It differs from the ordinary micrometer dial only in having deep but narrow V-grooves milled radially over its face and across its periphery. A spring detent is made of sheet steel, the working edge of which is nicely fitted to the grooves and is left quite hard while the body is spring tempered.

The detent may be made for either position, as the sketch shows, and by its use the advance of the screw any definite number of thousandths may be easily felt.

Why Not Bronze Nuts in Cross-Slides?

BY J. W. LAWSON

We have had considerable trouble with the cross-slides of a certain class of machine tool by reason of the nut on the slide being merely a tapped hole in the cast-iron body of the slide.

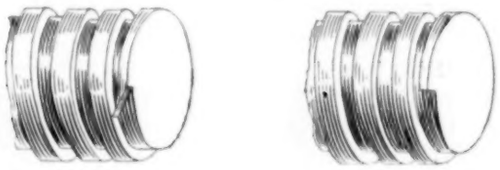
When the slide is run off the screw, as is frequently done by green operators, and they attempt to replace it without attracting attention, trouble is extremely liable to develop from the jamming of the thread, the first turn of which in the iron will probably be broken.

Frequent repetitions soon cause the whole thread to become bad, dirt and chips are worked into it with the result that it soon becomes loose and finally stripped.

The only remedy at this stage is to swing up the cast-

ing and bore it for a brass sleeve to replace the nut. The making of this small-diameter, square-threaded nut without a tap is some job for a shop of ordinary resources, yet it is the only recourse except the clumsy and unsatisfactory one, almost as difficult of accomplishment, of chambering the casting and running a babbitt nut around the screw.

Why do not manufacturers make the nut of brass or bronze and removable in the first place? Properly



FIXING THE END OF A SQUARE-THREAD SCREW

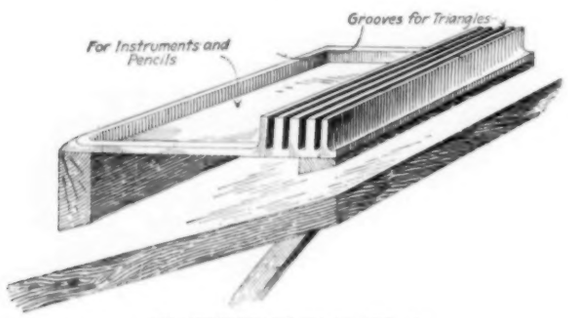
equipped for their manufacture the cost per machine could not be appreciably greater and the satisfaction to the customer would be immeasurable.

Another little point to consider is the thin end of the first quarter turn of a square thread. This end soon becomes broken and bent down, as shown in the sketch, and is a prolific cause of the trouble complained of above. A green hand who has run off his cross-slide and is trying to put it back surreptitiously will hammer away, trying to start a thread that will not start, until he has ruined half of the nut. We always chop these threads off square at the point where the full-section thread begins.

Tool Tray for Draftsman

By E. A. Kipps

The sketch shows a simple tray I made for use on my drawing board to hold tools. It can be made in a few minutes by anyone skilled in the use of wood-



DRAFTSMEN'S TOOL TRAY

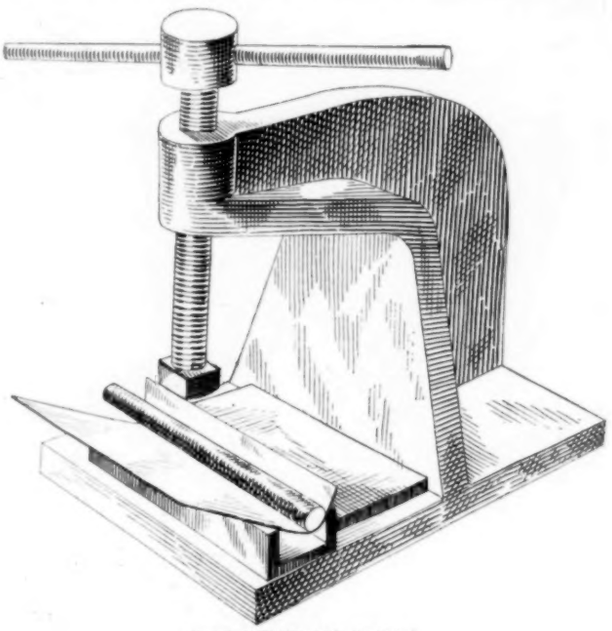
working tools and saves its cost many times over by keeping the tools where they can be readily found instead of having them sliding all over the board.

Guard for Planing Machine Ways

By H. Lauterbach

The method we used in bending guards for the ways of our planing machine may be of interest to the readers of the *American Machinist*. First, a sheet-iron pattern was cut to the required shape and height. A piece of channel iron 3 ft. long, a piece of 2-in. pipe the same length, a straightening screw, a hammer and a piece of iron to be used as a guide between the channel iron and the housing of the straightening screw were all that was required.

A guide line was drawn about 2 in. from the edge of the sheet iron and the first bend was made along this line. Another bend was made at about 2½ in. until the edge was about ¼ in. higher than the pattern. After the guard was bent on both edges the size across the



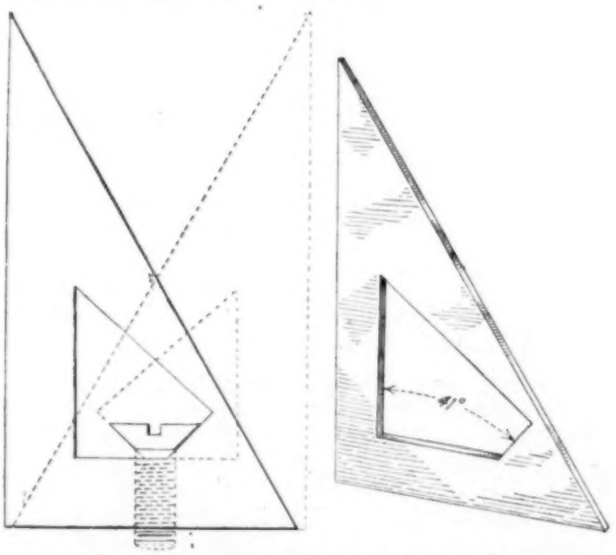
THE BENDING TOOLS

top was scant. This was remedied by laying the work bottom up on a narrow piece of iron and striking it with the hammer at the base of the curve, which opens it up to the required size. The sketch shows the way in which the tools were used.

Extra Angles on Triangle

By A. Kipps

Having frequent occasion to draw countersunk-head machine screws with included angle of 82 deg. I cut the center of an ordinary 60-deg. triangle to the shape shown in the sketch. It is little trouble to make and saves a deal of time on this work.



EXTRA ANGLE FOR DRAWING SCREW HEADS

EDITORIALS

The Price of Machine Tools

IN COMMON with customers in other lines, the users of machine tools are delaying the placing of orders in the hope of securing lower prices. This hope, we feel sure, will not and should not be realized except in a few extreme cases. Machine tools have, in general, been too low-priced in the past.

There are of course a few instances where prices have been unduly inflated, taking advantage of the necessity of the customer for an early delivery. But in most cases the builders of standard machines of high quality have not advanced prices unreasonably. Those who build machines which are the basis of all industry certainly deserve a fair return for their efforts; more than many of them have received in the past.

There is a noticeable difference between the average machine tool shop and the shops of other machine industries, and as usual there is a reason. With almost no exceptions the machine tool shop has come up from small beginnings. A machinist designed a new machine tool of some sort and started to build it in a small way with almost no capital. One or two men in a single room, with all the office work done at night (often by the wife), has been the beginning of many a well known machine tool shop of today.

In many cases the number of machine tools built does not allow of quantity production with its reduced costs. Then too, the fact that many of the builders are small in size and that the real amount of overhead expense is frequently not appreciated, has put the machine tool industry at a disadvantage in many ways. It has not, as a rule, seen its way clear to offer inducements either in the way of wages, salaries or shop conditions, equal to those of the automobile or other industries. As a result it has lost many good men who should now be in the ranks and who could have aided in its development.

The best interests of the country as a whole demand that superior mechanical talent be in that branch of the machine industry on which all of the others depend. This cannot be done unless the machine tool shop can offer at least as good opportunities for the mechanic and engineer as the other branches.

We believe that in most cases the present prices are justified and should be maintained. The profits secured by users of the machines are many times in excess of those realized by the maker and there is no room for just complaint on that score.

It is also necessary for the builders of machine tools to realize that the dignity and standing of the industry demand that its shops should be second to none in any way. There is no reason for them to take a secondary position or be content with anything but the best for themselves and their men.

This does not mean that this industry should demand or expect exorbitant profits. It should however always bear in mind that it is entitled to such a return as will enable it to maintain high-grade shops, to pay enough to attract the best men and still give a fair return on the investment.

Be Sure of the Right Medicine

HOW many times have you read of this or that estimable gentleman with a headache or other ailment getting up in the dark and taking a dose out of the wrong bottle? The headache never returns, but the undertaker is master of ceremonies shortly afterward.

How many times does business take the wrong medicine with similar results?

The readjustment period which we are entering is sure to contain many business disorders, and whenever any symptoms of disease appear business doctors of various kinds spring up with offers of medicine in great variety.

We are facing such a condition at the present time, and never was it more vital to avoid taking quack nostrums than at present. No matter how severe the headache, don't grope in the dark for the right bottle. Be dead sure you know the label and that you get the right bottle. The bankruptcy court is the undertaker for mistakes of this kind.

Most of the nostrums offered will be labeled "Efficiency" of some special brand and it's the brand that needs watching. Never mind the special name or the color of the label, but be sure that the "fish" part of it isn't dead or worse.

Too much of this kind of medicine is ten-tenths rules, charts and diagrams which go under the guise of management. It leaves out the human factor both in the manager and in the men in the shop. Real efficiency cares very much less about any particular system of rules and charts than it does about getting results; about getting dividends as the result of real coöperation, and about insuring the future as well as the present.

The German brand of efficiency made machines out of all but the chosen few. These were the planning department, and they never considered the individuality

of the workers. The system worked fine as long as it met no real obstacles, as long as it could be worked according to rules. But the Allies refused to know when the system said they were licked; which threw the system out of gear, and even the planning department couldn't get the schedule back into high.

There is no question but that most shops need a tonic after the last four strenuous years. But don't make the mistake of taking either a dope or an emetic. Liberal doses of mutual interest usually act as a real tonic. Coöperation is just as necessary in times of peace as it was in war. And the coöperation cannot be all on one side. It must come from both sides and meet in the middle. The great trouble has been that it has never met at all in too many cases.

Some of the best intentioned managers have never been in the shop and cannot appreciate the workers' point of view. Others who have grown up through the shop cannot realize that times have changed since they were workmen and see no reason why men should not now be content with all the discomfort they endured. Managers of this kind need an adviser or counsellor, and fortunately a new kind of business engineer has sprung into existence to meet the new emergency. But here again we must be careful not to pick up the wrong bottle in the dark.

First of all must come the desire for real coöperation, the desire to have the men take a real interest in the shop and its work. Next the manager must try to see things from the workers' point of view. He must try to see how things would appear to him were he in the shop instead of in the manager's office; to see how far he could or would be interested in anything but quitting time and pay day if he were merely a number on the payroll who could be fired at a moment's notice at the whim of a dyspeptic foreman.

Would he as a workman be content to have all the rules of his coming and going made for him without consultation or consideration of him as a human being at all? Would he enjoy having his first week's pay held by his employer until he left his job as is done in so many shops?

The feeling created by these things have probably never occurred to him as manager; they would appear very differently were he on the other side. And it is only by getting this other side that real coöperation and mutual interest can be acquired. The question of the method of payment alone has a greater bearing on shop harmony than many realize.

When a man has earned his week's pay he wants it. In most cases he needs it, as few have much surplus, especially if they have had a lapse between jobs. Loan sharks and pawnbrokers have waxed fat from men's necessities due to their needs. All realize the necessity of time to make up a payroll, but men object to the entire week's pay being held up on this account. Again those who realize how interest on deposits count up are very apt to do a little figuring as to the interest on thousands of dollars held up for a full week.

Then too men resent being treated like cattle when being paid off. Having earned the money they object to having to almost beg for it afterward. They feel that unless the management wanted their labor more than it wanted the money they would not have been hired, and believing that fair exchange is no robbery they feel that they should not be subjected to petty annoyances in getting what they have already earned. They object to standing in line like paupers at a soup kitchen for long and weary minutes after working hours, and often in the cold or rain, to get what belongs to them.

Some shops are finding that careful attention to this one detail has proved an excellent tonic in the matter of getting coöperation and loyalty. This human touch added to the cost system does much to make men forget other annoyances. One large concern devised a plan which divides the shop into groups of suitable size and pays off each group in its own department and on the company's time without fuss or bother or subjecting men to humiliating experiences. This firm insists on its paymasters being really human and not handing out the pay envelopes as though they were meant to be thrown to the lions in the zoo.

Other little human touches to take care of emergencies that arise, even in workmen's families, do much to create a bond of sympathy between the men and the management. Little accommodations that may even jar the workings of an iron-clad system occasionally often pay big dividends in good-will and real coöperation and loyalty.

Business needs good advice regarding the dealings with labor in these days of readjustment. But it wants to be very sure of its advisers and the brand on the medicine bottle. Patronizers or paternalism is not wanted—just plain, sensible personal relations, remembering that both sides are human, both sides liable to error and that all the brains are not in the office or even in the planning department.

Putting oneself in the other fellow's place, remembering that autocracy is not in style these days, that even its great exponent's (W. Hohenzollern) moustache is no longer turned upward, and that the shop which can obtain and utilize all the brains in its employ has every advantage over the rest, all point to the bigger problems of the present-day manager.

Beware of the quack doctor of any school, no matter how long he may have had his shingle swaying to the breeze. Consult the best specialists and don't swallow any medicine in the dark. The best tonic is common sense, even though we need some one of broad vision to show us the way to use it.

US ARMY ORDNANCE NEWS

History of the Aberdeen Ordnance Proving Ground—II

By MAJOR F. P. LINDH

The second installment of this history tells of some of the hardships of the early days of construction and the struggles that were made to overcome the difficulties. The organization adopted to handle the proving ground is described and some of the achievements of the various departments are recounted.

THE taking over of 35,000 acres of land naturally involved so many differences of opinion between the owners and the government that a commission of four disinterested men was appointed to handle the various appraisal problems which included everything from the value of swamp land to the losses entailed by the stoppage of hunting privileges. Eventually about three and a half million dollars were spent in acquiring the reservation and a three-mile right-of-way for a railroad to connect with the Pennsylvania at Aberdeen. It was discovered that only a few of the existing buildings could be used as most of them were in dangerous positions. This simplified the general plan somewhat as it meant starting from the bottom without any piecing and fitting. Plans for the structures that were most needed were obtained from the quartermaster and medical corps, and also from arsenals and manufacturers, and construction was begun as soon as the necessary surveys were completed.

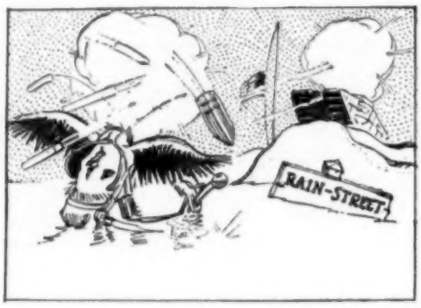
THE 9.2 IN. HOWITZER

As most of the large contracting firms of the country had their hands full with other government work it was decided to give the contract for construction to a local firm that was familiar with the conditions. This firm worked under a contract based on the sliding profit scale used in the quartermaster corps and its operations were supervised first by Major W. R. King and later by Major A. B. Roberts. The conditions under which the contract was carried on were difficult in the extreme. The laborers employed by the contractor had to commute from Baltimore while the civilian employees of the proving ground traveled from Havre de Grace. The trains were always overcrowded and generally at least an hour late due to the severe winter weather. The range observers who worked down the bay spent most of their time getting to and from their posts and obtained on the average about six hours sleep. The officers at first slept on desks in the flimsy office building as the quarters had neither light, heat nor water. When the power house was put in operation conditions were hardly improved because the water pipes were in a chronic frozen state. A story widely circulated was to the effect that an officer awoke one morning to find his room unusually warm; delighted at this and curious as to the reason he discovered that the water which he had left running the night before had spread over the floor and filled up the gaping cracks with solid ice which shut out the wintry breezes.

When spring came, the thermometer rose and the ice melted but this only meant a different kind of trouble. The latter was in the form of a mud developed by the prolonged thaw of the heavy snow, which was bottomless, glue-like and apparently permanently wet. No vehicle could be moved except a tractor. Horses and mules were stuck frequently even on the main street of the camp and in one instance a mule got in so deep that he had to be shot. Men fared little better and some required the aid of a team of horses to extricate themselves. The only casualties during this condition were those suffered by official dignity.

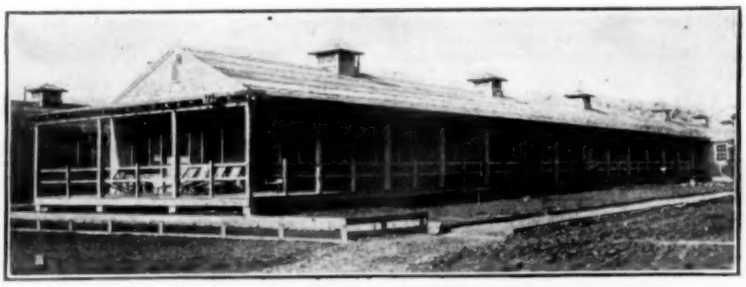
By April as the camp began to take shape and permanent structures were considered the gloom was somewhat lifted. The hospital, many barracks and a few office and stores buildings were in use and four ranges were in operation for different types of firing. A frame power house supplied water and electricity for the camp, and an officers' mess and a post exchange were in full swing. The roads became passable and the railroad connection to Aberdeen was open for traffic. Up to this

ARMY ORDNANCE NEWS



THE FIRST CASUALTY

time construction had been hampered by the necessity of providing for immediate needs before commencing permanent accommodations. Now, however, conditions had reached a stage where it was possible to start a brick storehouse and an instrument building. At first only the lighter guns were used at Aberdeen because of their relative mobility, the larger ones being left at Sandy Hook. Range firing began with the 2.95 in. mountain gun but the danger to observers of other firing and the difficulty of spotting the shots in the snow and underbrush necessitated a change to the old practice of firing over water. A fine residence about three miles from the main battery and situated on the shore line was chosen as a headquarters and connected by telephone with four range towers which were located by surveying across the ice. As the only transportation was by mule team the firing was carried on under great hardships but sufficient work was done by the end of March on the 75 mm. Bethlehem and 4.7 in. guns to provide the requisite data for range tables which were urgently needed by the artillery.



A WING OF THE HOSPITAL

One of the greatest difficulties encountered in early proof work at Aberdeen was the lack of suitable chronographs or velocity instruments. The standard type which had been in use everywhere for years took too long to complete and the supply was totally inadequate. As a result it was decided to devise a new instrument and the problem was turned over to Captain A. L. Loomis who, with the aid of Dr. Klopsteg of the Bureau of Standards, carried through researches and experiments which resulted in the Aberdeen Chronograph. This instrument was developed in a surprisingly short time and its design and immediate successful installation on a large scale at Aberdeen must be rated as a notable achievement.

The trench warfare range was a particularly interesting project because of the new type of weapon and the lack of precedent in the Ordnance Department for its use and testing. The guns tested here varied from the Stokes mortars and the 8-in. Livens projectors which are simply gas pipes closed at one end, to the 11 in. Sutton mortar which is an original and clever English weapon with a range of 4,000 yd. Rifle grenades were also tested in large quantities.

In May and June the 5 and 6 inch and the anti-aircraft guns were sent down from Sandy Hook and at about the same time the first of the new model 75's arrived for exhaustive tests. The English system of mirror position finders for the accurate location of shrapnel bursts high in the air was installed and with this apparatus the first accurate range firing of anti-aircraft guns in the United States was performed.

The administration of the Aberdeen Proving Ground was conducted by a staff of officers commanded by Colonel William A. Phillips, a regular army man with a long service record and a reputation as an expert on explosives. Six departments were formed called Administration, Construction, Proof, Military, Property and Service, each under a major who divided his work into sections headed by captains or majors. Civilians were employed for advisory and special duties but the control was entirely in the hands of officers. On Christmas, 1917, the operating staff included some two score officers but by April this number had grown to 120 and to over 300 at the time of the armistice. There were 1,130 enlisted men in April and 4,800 in November, while the civilian staff grew from 650 to 900. As far as possible the work was done by the enlisted men to maintain the military character of the post and they did everything from truck driving and farming to army paper work. Many of the civilians among whom were stenographers, machinists, electricians and clerks, came from Sandy Hook where they had had previous experience in ordnance testing work and the first enlisted men were drawn from the same source. Later demands of course were far in excess of the capacity of this supply and the second large contingent was taken from organizations recruited by voluntary enlistment to establish ordnance bases overseas but which were disbanded after changes in plans had postponed these projects. Most of the later recruits came from among

A COMMON OCCURRENCE ON MAIN STREET IN SPRING

ARMY ORDNANCE NEWS

men rejected at the large camps for overseas duty. The post band, the Y. M. C. A. hut and the post exchange did their best to brighten the rather arduous duties of the men. A weekly newspaper called the "Rapid Fire" was started and proved a success.

The hospital has been one of the most indispensable features of the proving ground as the severe weather of the first winter and the hazardous nature of the work made sickness and injury frequent. About 400 patients a month were admitted when the work was in full swing and the present capacity is 225. The present buildings of the post are arranged in ten groups; the headquarters group composed of the barracks, hospital and office buildings; the officers' quarters group on Plum Point; the utilities group containing the power house, instrument building, machine shop; the main battery group of ammunition and artillery repair sheds, chronograph buildings and powder magazines; the group of civilian barracks at the head of Swan Creek, the aviation field, trench warfare, detonating and water ranges and the village of Old Baltimore near the bombing field. In addition to these there are sixty houses in process of erection at Aberdeen to be rented or sold to permanent Ordnance employees.

THE BEST WAY TO ELIMINATE DRAFTS AT ABERDEEN

The water supply of 1,000,000 gallons per day is drawn by air lift from wells dug on the reservation and stored in a large reservoir and several tanks. The normal pressure is 50 lb. which can be doubled in case of fire. The quarters and offices are supplied with all modern conveniences, including hot water. The central buildings are supplied with steam heat and electric light from the power plant but the outlying ones are independently supplied. Most of the power will be used by the machine shop which is equipped with heavy cranes for handling the big guns. A large plant has been erected to take care of the sewage disposal.

There are now about 30 miles of railroad on the reservation with two freight yards and a connection with the Pennsylvania main line. The rolling stock consists of 10 locomotives and 25 cars, some of which, notably the "General Rodman" locomotive, came from Sandy Hook. The post has its own telegraph office, post office, railroad station and telephone exchange, all operated by enlisted men or department employees.

The garage has been one of the most useful and at the same time most maligned institutions on the grounds. Before the railroad was built its automobiles provided the one practicable means of transportation to the outside world as well as to the outlying activities, and even after trains were in operation there were more calls for cars than could be answered. Operation of the cars twenty hours a day through real mud over country roads resulted in constant need for repairs, while the complete lack of facilities and the inexperienced personnel rendered repairs difficult. Consequently, a proving ground car could usually be told afar by its dilapidated appearance, its missing cylinders or its absence of lights. Nevertheless any kind of car was a hundred times better than walking four miles to Aberdeen in the spring of 1918 as many an enlisted man will testify. Besides for a major a real car was forthcoming on request. Vigorous criticism would be lavished on the garage when an officer arrived at Aberdeen at 4:30 a.m. Monday morning after a week-end trip to find no car available, and two hours to wait or four miles to walk.

In addition to its passenger cars the garage maintained an extensive truck service, operating truck trains to Baltimore, Philadelphia and New York to obtain supplies for the quartermaster or the post exchange and to convey Ordnance materials to and from factories, arsenals and points of embarkation. The drivers of these vehicles were enlisted men of many types; a hotel owner whose chauffeur took him about in his own car when he was on furlough, a New York taxi driver, a racing chauffeur, and farmer boys who had never

8-INCH HOWITZER ON TRACTOR MOUNT

155 MM. GUN ON TRACTOR MOUNT

ARMY ORDNANCE NEWS

8-INCH RAILWAY GUN AT FULL RECOIL

driven a car before. The most interesting feature of the garage work has been the operation of powerful tractors in hauling guns about and in extricating trucks from mud holes. It is remarkable to see the ease and rapidity with which a small tractor can come up to a big truck, pivot about, hitch up with a chain and start off with the truck, however deeply the latter may be imbedded in mud. At present the garage operates about 70 touring cars and 80 trucks.

The Quartermaster Department does a large business at Aberdeen. In addition to supplying all the enlisted personnel with food, clothing and pay, and performing other routine duties, it has carried on extensive farming operations on the quieter portions of the ranges. Many fields were planted with winter wheat by the farmers in the fall of 1917 and many other fields were sown by soldiers in the spring of 1918. Some 1400 tons of hay and straw and 2,000 bushels of wheat were harvested on the reservation up to July, 1918. In addition plentiful fruit crops were gathered, notably several thousand baskets of peaches from Poole's Island. These crops were either used on the post or sold in Baltimore markets for the benefit of the Government. Over 1100 tons of hay and straw and 700 tons of grain were used by livestock on the post during the year of 1918.

Forestry and game preservation agencies have been considered, but little work has been done in these lines as yet. No hunting is allowed on the reservation and it is hoped that the proving ground will form a very valuable game preserve since peace time firing will not disturb wild life to any great extent. The fishing industry in the Bay is somewhat interfered with by the maintenance of a restricted area along the western shore of the Bay, where the firing is done, and by the killing of fish owing to the bursting of high explosive shell on the water, but these interferences will largely diminish under peace conditions. Fortunately the deep water channel for shipping is very near the eastern shore of the Bay and the western portion of the Bay is shallow, so that commercial shipping is not affected.

In July, 1918, the proof work, or actual firing at the proving ground took a sudden spurt so that over 50,000 rounds were fired that month, and consequently a larger number of firing officers was required. In recognition of the great volume of firing that was to be done and of the necessity for its rapid conduction, the Ordnance Department had started several other proving grounds to perform routine work of powder testing and of proof firing guns for acceptance, leaving the experimental work and the major caliber guns to Aberdeen. In this way all powder tests for the 75 mm. gun were actually performed by Carney's Point Proving Ground which is adjacent to the Du Pont Powder Co.'s works. The development of gas warfare was done at Lakehurst, and the proof firing of 75 mm., 4.7 and 155 mm. guns and howitzers was largely performed at the Savannah, Scituate and Erie Proving Grounds. Most of these new firing grounds were late in starting and many officers whose experience at Aberdeen rendered them particularly valuable to the new posts were transferred there.

In addition to these calls for more officers, the A.E.F. required some for duty overseas, as the practical knowledge of an Aberdeen proof officer was highly valued in France. These demands for commissioned personnel were met at Aberdeen by the Ordnance School, which

240 MM. HOWITZER

ARMY ORDNANCE NEWS

received enlisted men as candidates from many Ordnance posts, gave them three months' intensive training and commissioned them as second lieutenants. Over 150 officers were so commissioned during the war.

A Railway Artillery School which, like the Ordnance School, had first existed at Sandy Hook, was transferred to Aberdeen when the railway guns began to arrive there. In this school selected enlisted men were trained in the care and handling of heavy guns and then sent overseas as repair units. Seventy-five men went overseas from the school in three batches.

PERSONALS

Second Lieut. Arthur Littman has left the service. His home is in Richmond, Mo.

* * *

Capt. H. C. Lea has been discharged. He was formerly employed as an engineer by the Municipal Authorities at Aspinwall, Penn.

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Capt. Chas. F. Derby, who was commissioned in December, 1917, has left the service. He attended Drexel Institute and is a civil engineer.

* * *

Lieut.-Col. George J. Siedler has been discharged. He is a graduate of Princeton University and was formerly employed by the Vim Motor Truck Co.

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Second Lieut. James P. Williams, who was formerly employed by the Southern Millwork Co., Orlando, Florida, has been discharged. He is a civil engineer and a graduate of Yale University.

* * *

First Lieut. Stanley L. Richter, who was commissioned from Plattsburg in November, 1917, has left the service. He is a graduate of Columbia University and practices law in New York City.

* * *

First Lieut. Karl M. Knapp, who was commissioned in December, 1917, has left the service. He attended Valpariso University and was formerly employed by the Haynes Stellite Co., Kokomo, Ind.

* * *

Lieut.-Col. Henry O. Bernhardt, who was commissioned in January, 1918, has left the service. His home is in Ypsilanti, Mich., and he was formerly employed by Harroun Motor Corporation, Hayne, Mich.

* * *

Maj. O. K. Wright, who was commissioned from Fort Snelling Training Camp in August, 1917, as First Lieutenant, has been discharged. He was formerly employed by M. K. Shafer & Co., Omaha, Neb.

* * *

First Lieut. James C. Patterson has left the service. He is a mechanical engineer and a graduate of the University of Pennsylvania. He was formerly employed by the Standard Cotton Co., Philadelphia, Penn.

Second Lieut. Chauncey McC. Ogden has been discharged. He enlisted in March, 1918, and is a graduate of Colgate University. He was formerly employed by the Firestone Tire and Rubber Co., Akron, Ohio.

* * *

Capt. Harold A. Brooks, who, before entering the service, was employed by the Potomac Electric Power Co., has been discharged. He is an electrical engineer and a graduate of the University of Sydney, Australia.

* * *

Capt. Charles E. McQuigg has left the service. He is a mining engineer and a graduate of Ohio State University. Before entering the service he was associate professor of metallurgy, Pennsylvania State College.

* * *

Capt. Harry H. Sherman of Milford, Mass., has been discharged. He is a mechanical engineer and a graduate of Worcester Polytechnic Institute. He was formerly employed by the Webb Granite Co., Milford, Conn.

* * *

Capt. Harold P. Hobart, who was commissioned in November, 1917, has been discharged. He is a graduate of Yale and a mechanical engineer. He was formerly employed by MacIntosh, Hemphill & Co., Pittsburgh, Penn.

* * *

First Lieut. George M. Humphreys has been discharged after nearly sixteen months' service. He is a graduate of Yale and has been employed by the Cleveland Hardware Co., Cleveland, Ohio, as production engineer.

* * *

Capt. John J. Ehrhardt, who was formerly employed by the Allied Sugar Machinery Corporation, 120 Broadway, New York City, has been discharged. He is a mechanical engineer and a graduate of Stevens Institute of Technology.

* * *

Capt. Edward F. Randolph, who was commissioned in November, 1917, has been discharged. He is a graduate of Stevens Institute of Technology and was formerly employed by the General Electric Co. His home is in Glenridge, N. J.

* * *

Capt. Joseph C. Andrews, recently discharged, entered the service as First Lieutenant in November, 1917. He is a Cornell graduate and a chemical engineer and was formerly employed by the American Hardware Corporation, New Britain, Conn.

* * *

First Lieut. Walter H. Schleck recently discharged, was commissioned from Fort Sheridan Training Camp. He is a graduate of the University of Wisconsin and has specialized in factory accounting. He was formerly employed by the Fountain Specialty Co., Grand Haven, Mich. His home address is 706 Monroe Ave., South Milwaukee, Wis.

ARMY ORDNANCE NEWS

Capt. Frank Brookfield, recently discharged, was formerly with the Brookfield Glass Co., 2 Rector St., New York City. He is a graduate of Yale.

* * *

Maj. William S. Conant, who was commissioned as Captain in June, 1917, has been discharged. He is a consulting engineer with offices in Detroit, Michigan.

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Second Lieut. William A. White, Jr., who was employed by the Gamble Motor Car Company, Toledo, before enlisting a year ago, has been discharged.

* * *

First Lieut. George W. Fowler has been discharged. Before being commissioned in January, 1918, he was employed by Evans & Howard Fire Brick Co., St. Louis, Mo.

* * *

First Lieut. Rudolph H. Fox, who was commissioned in August, 1917, has left the service. He is a graduate of the Massachusetts Institute of Technology and is a mechanical engineer.

* * *

First Lieut. Sidney Coolidge, Jr., has left the service. He is a graduate of Harvard University and was employed by the Union Tool Co., Torrance, Calif. His home is Concord, Mass.

* * *

Capt. George E. Brown, recently discharged, was formerly employed by the Aluminum Co. of America. He is a graduate of Yale and was commissioned First Lieutenant in August, 1917.

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Capt. Mark H. Robinson, who was employed by Eaton, Crane and Pike, Pittsfield, Mass., before entering the service, has been discharged. He was commissioned First Lieutenant in August, 1917.

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First Lieut. Philip J. Degnon, who was formerly employed by the Rowe Co., Plantsville, Conn., and was commissioned in January, 1918, has been discharged. He is a graduate of Manhattan College.

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First Lieut. Harry D. Balsinger, recently discharged, was formerly employed by the American Steel Foundry, Sharon, Penn., as production engineer. He is a graduate of Carnegie Institute of Technology.

* * *

Capt. Herman L. Wittstein, who entered the service as a First Lieutenant in June, 1917, has been discharged. He was formerly Works Manager of the Standard Fuze Corporation, Paulsboro, N. J.

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Second Lieut. Herbert L. Greiner, who entered the service in November, 1917, has been discharged. He attended Drexel Institute and was formerly employed by Niles-Bement-Pond Co., as machine designer.

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Capt. Samuel W. Forder, lately discharged, was commissioned in June, 1917. He is a graduate of Washington University and a chemical engineer. He has been doing consulting work with offices at St. Louis, Mo.

First Lieut. Gordon B. Ellicott, who was commissioned in August, 1917, has been discharged. He is a graduate of Williams College and a textile engineer. He was formerly employed by Cheney Bros., South Manchester, Conn.

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First Lieut. Carl A. Kuhr, commissioned in January, 1918, has been discharged. He has been connected for many years with the automobile business, particularly the racing end of it. His home address is 3400 Bishop St., Cincinnati, Ohio.

* * *

Second Lieut. Glenn A. Hammon, who has been discharged after eleven months' service, is a mechanical engineer and a graduate of Stanford University. He was formerly employed by the Hammon Engineering Co., San Francisco, Calif.

* * *

Capt. Stuart Thomson, who was commissioned as First Lieutenant in December, 1917, has left the service. He is a chemical engineer and a graduate of Harvard University. He had been employed by the General Electric Co., Schenectady, N. Y.

* * *

Capt. E. R. Baird, who entered the service as Second Lieutenant in August, 1917, has been discharged, and will return to the Union Gas and Electric Co., Cincinnati, Ohio, by whom he was formerly employed. He graduated from Yale as an electrical engineer.

* * *

First Lieut. John W. Elmes of Brooklyn, N. Y., was discharged on Feb. 20. He is a graduate of New York University and has had many years' experience in the New York National Guard, before entering the Federal service. He is a member of the New York Bar.

* * *

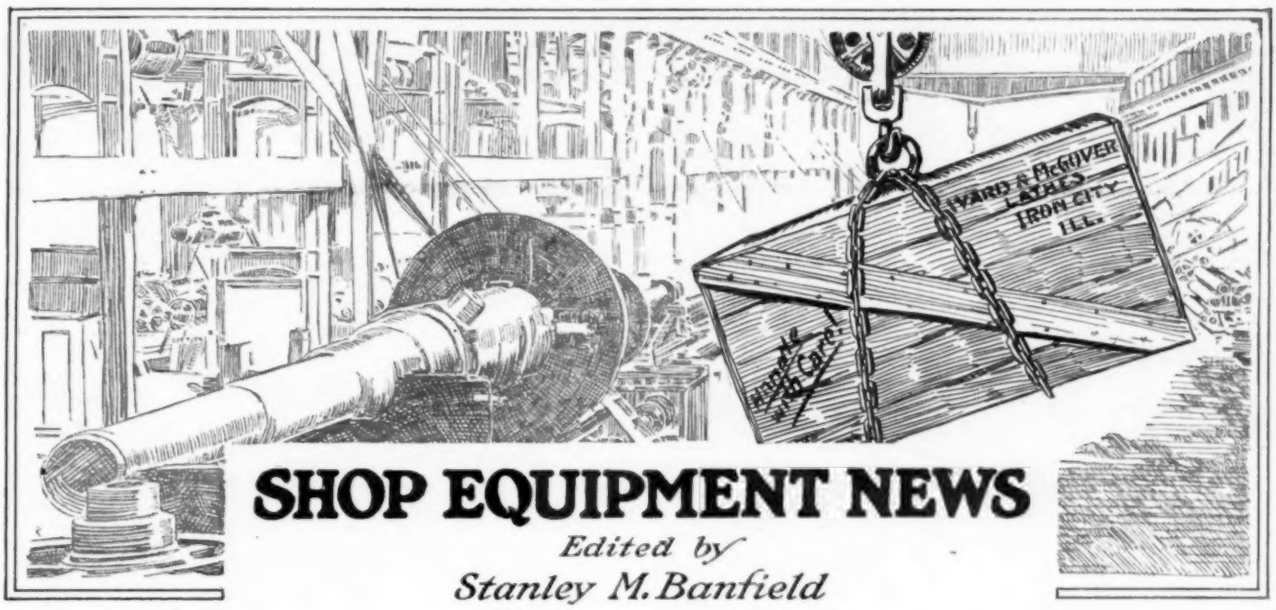
First Lieut. William S. Doscher has been discharged after sixteen months' service. He served nearly twenty years in the New York National Guard, and was with the American Express Co., 65 Broadway, New York City, before he was commissioned in the Ordnance Department.

* * *

L. S. Gatter, who as a First Lieutenant, was head of the Planning Section of the Inspection Division, Ordnance Department, U. S. A., for over a year in Washington, announces that he has become associated with William O. Badger, Jr., in the practice of law at 100 William St., New York City.

* * *

Two former employees of the General Electric Co. at the Pittsfield, Mass., works were recently discharged. They are Capt. Irvin P. Thompson, who was commissioned in February, 1918, and First Lieut. Elihu G. Sibley, who was commissioned in June, 1918. Captain Thompson is an electrical engineer and a graduate of Pennsylvania State College, while Lieutenant Sibley is a mechanical engineer and was graduated from the University of Michigan.



SHOP EQUIPMENT NEWS

Edited by
Stanley M. Banfield

Kent Bar-Stock Racks

The Kent Machine Co., Kent, Ohio, has just placed on the market two types of bar-stock racks. Fig. 1 shows the unit for long stock, while Fig. 2 shows the unit for short lengths. Referring to Fig. 1 the arms for long stock are made in single sectional units which may be spaced any distance apart to accommodate the length of stock to be held. Each one of these units is made up of a number of interlocking sections so that any number of arms and any height of unit may be easily obtained. The base is heavy and projects out beyond the longest arm, thus giving stability and keeping the center of gravity of the load within the area of footing. It will also be noticed that the base is provided with a projection at the outer end in order that it may also be used for holding stock. The spacing of the arms is varied by using interlocking space collars and large spaces may be obtained for light bulky material, such as tubing. All arms and spacing collars interlock with the base and no set screws or holding devices are required in the assembly. The holes in the sectional pieces are bored to fit the vertical spindle and the interlocking devices are fitted so that there is practically no lost motion. With the combination of adjustable spacers and arms furnished, practically any rack size can be easily secured.

Fig. 2 shows the three arm sectional interlocking unit complete in itself for the storage of short lengths of stock. The construction of this unit is practically the same as the preceding one except that the arms are provided with three resting points for the stock instead of one, in order to conveniently handle the short lengths. Both types of racks are constructed of cast iron, and it is stated that the arms are of such strength as to carry all the material that can be stored on them.

"Loway" Sine Bar

The A. F. Way Co., Inc., Hartford, Conn., has just placed on the market the sine bar shown in the illustration. The material used in the construction of the bar is all heat treated. It will be noticed that the two rolls on which all measurements are made are inserted

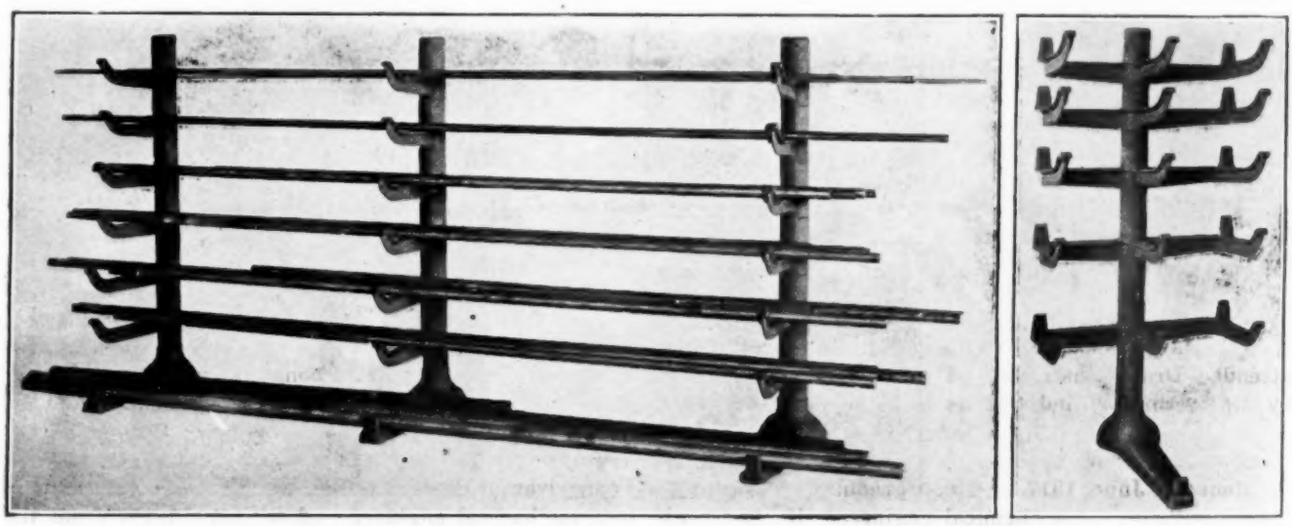
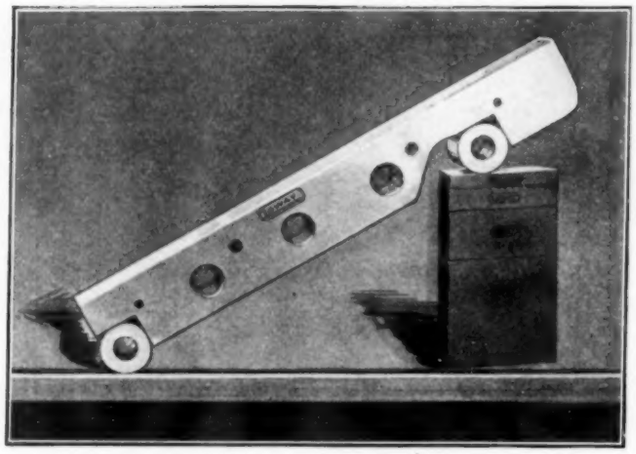


FIG. 1 AND 2. STORAGE RACK FOR LONG BAR-STOCK AND RACK FOR SHORT BAR-STOCK



THE "LOWAY" SINE BAR

in two right angle notches cut in the side of the sine bar. These rolls are held in place by a small coil spring passing through the side of the roll and into the sine bar, the ends being held by small pins. This construction is used to prevent any distortions and to keep the rolls in place at all times. The bar is provided with three holes, by means of which it can be attached to an angle plate. A feature of the outfit is the table of vertical setting constants, which gives at a glance the distance the high end of the bar must be raised in order to give any desired angle, this distance generally being secured by means of size blocks.

Presto Thread Grinding Attachment

The Presto Machine Works, 124 Pearl St., Brooklyn, N. Y., is now marketing the thread grinding attachment shown in the illustration. The device is intended to be attached to a bench lathe and its range on external work is up to 6 in. outside diameter and on internal work up to 4 in. in diameter. It is a development of the machine shown on page 267, Vol. 47. The attachment is so arranged that the wheel is permanently located with relation to the center line of the work and adjustments for diameter and depth of cut do not disturb the original setting of the head. Fig. 1 shows the machine performing a grinding operation, while Fig. 2 shows the machine with the wheel-truing attachment in place. The wheel is dressed after being adjusted to the helix angle and the dresser is so arranged that it can be swung out of the way when not in use. The spindle is mounted in a quill provided with adjustable bearings, the entire assembly of spindle, quill and bearings being easily removed from the machine. The bearings are bronze, tapered on the outside with a cylindrical hole for the spindle. The thrust is taken care of by a collar on the spindle which bears against a hardened-steel thrust washer, and the construction is such that adjustments to take up wear are easily made. All adjustments are equipped with accurately divided collar nuts to facilitate minute adjustments and a thorough lubricating system is provided.

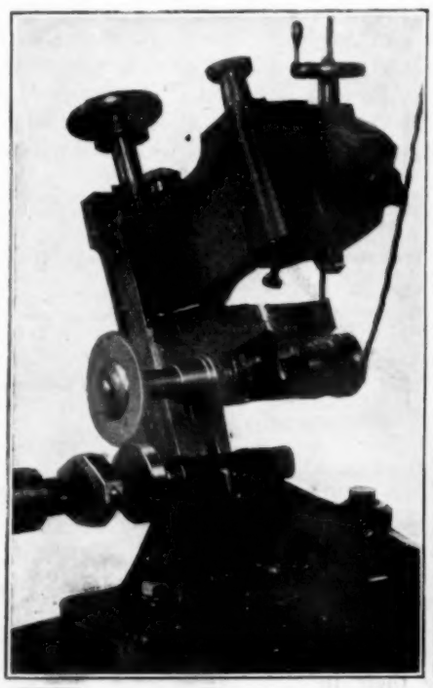


FIG. 1. MACHINE PERFORMING A GRINDING OPERATION

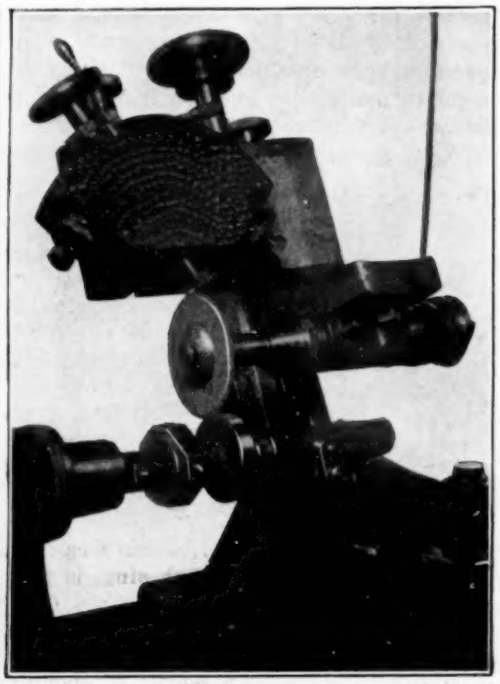
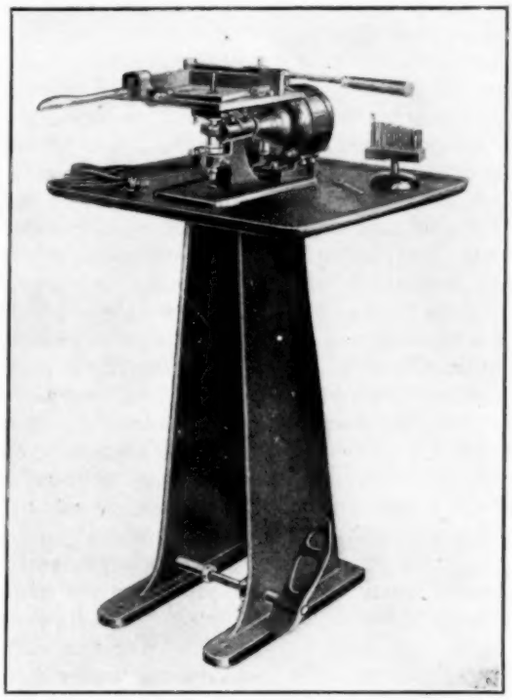


FIG. 2. MACHINE WITH THE WHEEL-TRUING ATTACHMENT IN PLACE

Anderson Bench Type Die-Forming Machine

The Anderson Die Machine Co., Iranistan Ave., near Admiral St., Bridgeport, Conn., has just placed on the market an improved form of die-forming machine. One of the very important features has been the incorporation of ball bearings on the main spindle. The lever at the front of the machine for releasing the cutter has been removed and a drawbar substituted allowing the chuck to be tightened by means of a wrench. This is said to make a very much more rigid construction. In order to hold the spindle while tightening or loosening the drawbar, a locking pin has been provided, which is held in a suitable opening in a portion of the main frame, just above the lower bearing at the front. This engages a hub forming part of the spiral gear and by inserting the plug, the spindle is held rigidly. The base of the machine has also been lengthened somewhat in order to secure a more rigid motor mounting. The motor is set on a block having the under face in the form of an inclined plane so that the height or distance from the bottom of the motor to the shaft center can be readily adjusted by moving the motor up or down the plane as necessary. Both bench and floor type of machines can be furnished. In the floor type the switch for starting and stopping the motor is connected to the treadle shown at the right. A spring that may be

seen at the left end of the treadle shaft, serves to return the treadle to normal position. The switch is so arranged that a downward pressure on the treadle will start the motor. The foot can be removed, the treadle returning to normal position and the machine continuing to run until another downward pressure is made.



ANDERSON BENCH TYPE DIE-FORMING MACHINE

Capacity, cutters, $\frac{1}{16}$ to $\frac{5}{16}$ in. in diameter; thickness of dies worked, $1\frac{1}{2}$ in.; working surface of table, 8 in. square; height from bench over all, 12 in.; main spindle, chrome nickel steel hardened and ground; main spindle bearing, S.K.F. radial ball; chuck, draw back, with maximum capacity of $\frac{1}{4}$ in.; weight of bench type with motor, 85 lb.; weight of floor type, with motor, 290 lb.; regular equipment consists of machine equipped with 110 or 220 volt alternating current, 60 cycle single phase motor, or 110 or 220 volt direct current motor with flexible cord attachment, plug and switch, portable tool rack, one set of 12 cutters, pivoted universal feed lever and necessary wrenches.

This feature obviates the necessity for the operator holding his foot on the treadle all the time. All wiring is on the inside of the pedestal and is protected by conduits.

Arrow Thread-Lead Testing Device

A device, shown in Fig. 1, for testing the lead of thread gages has been constructed by the Arrow Tool Co., 200 Cannon St., Bridgeport, Conn., primarily for the purpose of testing the gages which have formed a large part of their own shop product and also with the intention of manufacturing it for the market as soon as business conditions warrant.

The base *A* of the machine is of cast iron ribbed on the under side like a surface or bench plate, with a special large rib running the full length of the casting under the point where the T-slot for the center supports is afterward milled.

The slideway *B* that carries the measuring parts is of mild steel, which after machining, is pack-hardened, ground and lapped to size. The slides *C* carrying the gaging pieces, and *D*, on which is mounted the micrometer measuring head, are carefully fitted to this slideway *B* and provided with means of clamping them in place.

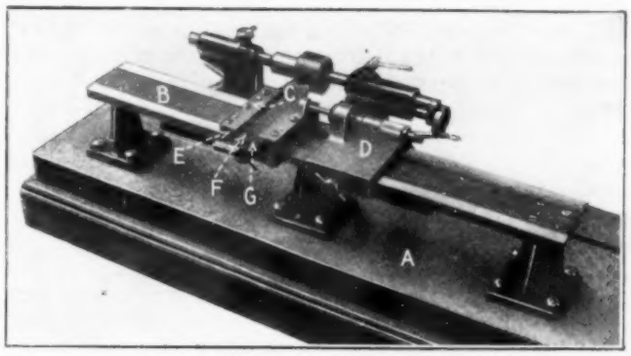


FIG. 1. THREAD-LEAD TESTING DEVICE

The gaging pieces *E* and *F* and the spacer *G* are of tool steel $\frac{1}{4}$ in. thick and $\frac{1}{2}$ in. wide and are closely fitted to the slide *C*. When they are arranged with the pieces *E* and *F* adjacent and the spacer *G* to the right, as shown in the cut, the gaging points are $\frac{1}{2}$ in. apart. With the spacer *G* between the gaging pieces this distance is 1 in. The advantage of this adjustment is obvious, as progressive errors will be more readily apparent when the gage to be measured is long enough to permit the wider spacing.

To use the device the gage to be tested is placed on the centers and tightened. One of the gaging points is then brought into contact with the gage, observation being made against a piece of white paper or other reflecting material laid on the base of the machine.

After this adjustment is made the slide *C* is clamped, and the measuring spindle of the micrometer head, which has been brought to some predetermined reading—say 0.100 in.—is brought into contact with the raised hub on slide *C*, and slide *D* is then clamped. The micrometer spindle is then turned back, the first gaging point is withdrawn and the second one advanced to contact with the thread. The gage under test must not be allowed to rotate on the centers. If any error exists it must be met by moving the slide *C* along the slideway until the second gaging point is in contact. When this is done the variation from true lead is measured directly plus or minus with the micrometer.

The top surface of the gaging pieces are in the same plane as the centers which support the work to be gaged. The points are beveled back sharply on the under side, so that the contact is virtually a knife edge and very minute errors are easily detected. All parts of the device are made with the utmost care, every essential part being lapped with the same degree of precision that is accorded to gage work.

Fig. 2 shows a peculiar light effect, advantage of

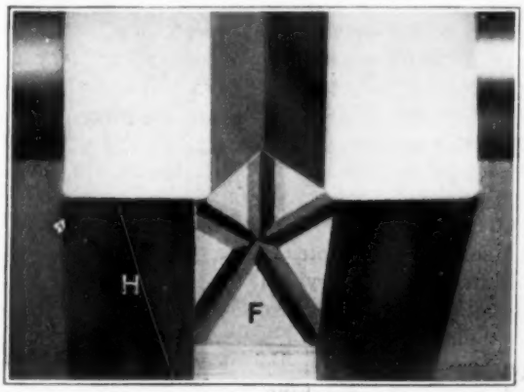


FIG. 2. THE SHADOW BANDS

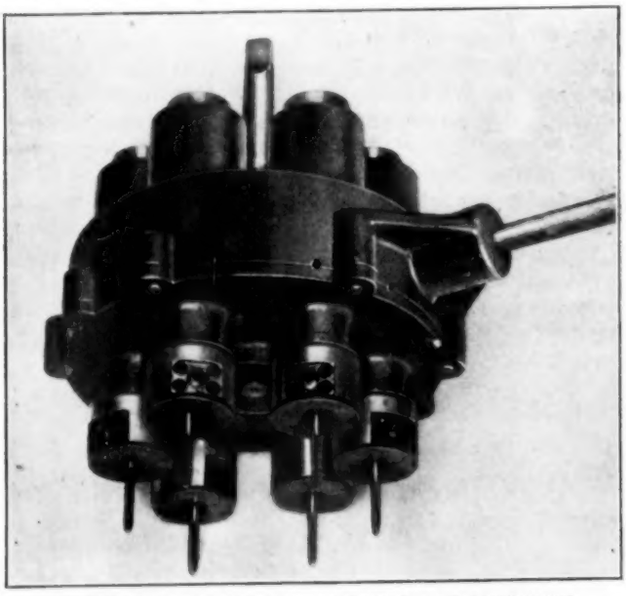
which may be taken in testing the gaging points of the machine. In this figure *H* is a gage, sometimes known in shop parlance as a "rat trap," which is used for setting a threading tool to do accurate work. While many of these gages are round, this particular one is square, and as shown in the cut is mounted on an arbor on the centers of the lead tester and set square with the base. *F* is one of the gaging points turned bottom side up.

Attention is called to the five bands of light and shade radiating from the center, which are caused by the reflection of the gaging point in the polished sides of the groove. In pushing the gaging point slowly into contact with the gage the operator may observe these shadow bands closing in very much after the manner of the iris diaphragm used in photographic apparatus, and any departure from absolute truth, being greatly exaggerated, is rendered very conspicuous.

Gaging points are of course provided for each different form of thread to be gaged.

Dorman Tapping Attachment

The illustration shows one of a line of multiple spindle tapping attachments placed on the market by John H. Dorman & Son, 1-9 Bethune St., New York City. The particular device shown is for tapping six



DORMAN SIX-SPINDLE TAPPING ATTACHMENT

holes at one time in ¼-in. sheet steel, 10-32 taps being used. The attachment is intended to be attached to the ordinary drilling machine by means of a taper shank and it is stated that it will tap from six to eight pieces per minute. The case is made of aluminum in order to reduce the weight, and the spindles are gear driven.

Nonferrous Metal Castings by the Morris Process

The Morris Engineering Co., 39 Cortlandt St., New York, is making nonferrous alloy castings under pressure. Some of these castings were tested by the Bureau of Standards and show unusual results. The tests made by the bureau of an alloy made up of 90 parts aluminum and 10 parts copper, on specimens from the same melt, some cast in sand and others by the Morris process, were reported as follows:

"The 10 per cent. copper-aluminum alloy as sand cast showed a normal tensile strength of approximately 20,000 lb. per square inch, with an elongation of approximately 1 per cent. (forged) as compared with tensile strengths of from 35,000 to 40,000 lb. per square inch and elongation of from 8 to 10 per cent. of the same alloy when in the drop-forged condition. The strength of the drop-forging is almost double, the ductility from 5 to 10 times as great and the toughness therefore, from 10 to 20 times as great as that of the sand casting. Hard castings can be produced in sand or in dies, but they are without exception brittle, having very little ductility."

Private laboratory tests made under the company's direction show that an alloy of 60 parts copper, 40 parts zinc and a trace of lead has an ultimate tensile strength of 49,500 lb. per square inch, an elastic limit of 29,750 lb. per square inch and an elongation of 45.5 per cent. in 2 in. An alloy of 86.5 parts of aluminum, 12 parts of zinc and 1.5 parts of copper gave results of 42,700 lb. per square inch ultimate strength, 29,400 lb. per square inch elastic limit and an elongation of 12.5 per cent. in 2 in.

A large order for fuse bodies for the British under specifications which called for an elongation of 7 per cent. in 2 in. in an alloy of 80 per cent. aluminum and 20 per cent. zinc was filled, with only 5 per cent. rejections, and the product showed an ultimate strength of 41,440 lb. per square inch, an elastic limit of 30,400 lb. per square inch and an elongation of 14.47 per cent. in 2 in.

It is claimed that an application of the process can be made to aluminum-alloy gas-engine pistons, reducing the coefficient of expansion by adding a small amount of iron to the aluminum and copper, and that the greater strength of the Morris-process casting would permit of an appreciable reduction in weight.

A System That Didn't Save

BY JOHN R. GODFREY

System and standardization are alike in one respect—it's always a question of how far you can carry either one without busting up the whole works.

Now, there's my friend Johnson, who is head of the whole outfit in the biggest shop in town. The war has thrown all kinds of work their way, and having more money than ever before he hired several system sharks to fit him up in the way he should go. And they got busy with a vengeance. You might have thought they were working piecework by the number of forms they devised and wished on the unsuspecting Johnson.

Before he really knew what they were doing to him he was carrying 20 per cent. of his people on the nonproductive list and had had system till he couldn't see. It so happens that his business consists of several departments which are in entirely different fields, and that the men in one field know absolutely nothing about the other.

A little thing like this, however, couldn't interfere with the system of centralization, and all went into the common melting pot. Draftsmen who had special-

ized on fine-instrument work were told that they must handle anything which came along, from voltmeters to boring mills. So the best ones promptly quit because they saw no chance of getting anywhere with such a hashed-up organization.

I happened along with Johnson one morning as he went through the drafting room. One of his best men was busy signing slips, dozens of them, and Johnson asked him what he was doing.

"Complying with the system, Mr. Johnson," he said. "You see I've got to make a few changes on one of the drawings of that XX voltmeter. I used to send a boy for the tracing from our own file, make the change and note it, recall all blueprints, issue new ones, return the tracing to the file and the job was done. It's different now.

"Foolem and Gouger didn't like that system. Said all drawings ought to be in the same file, no matter whether it's a voltmeter or a washing machine. So they've taken our tracings, given 'em serial numbers and had 'em filed along with the boring mills, washing machines and other junk. Sometimes that's the last we see of them—you know how hard it is to file letters

by the thousand and ever find the one you want every time?

"I sent to the drawing files for these tracings yesterday morning—just got 'em. There are 67 in the set, and they are bound together. They haven't taken them apart yet, but I presume they will soon—then we never find over half of 'em. I've got to change one drawing, but I've also got to sign a receipt for every blamed tracing in the binder—67 of 'em—got 23 more to sign.

"Along about noon I'll get to work if they don't spring a new one on me in the meantime. These receipts are only good for three days. If by any chance I can't get this change made in that time I've got to send these tracings back to the central file, send another requisition for them and decorate 67 more pink sheets with my famous autograph before I can finish the job.

"Gives me a lot of practice, and I sure do appreciate writing lessons on your time. I'll either be a star writer or else write so badly you can't read it by the end of the month."

Johnson wasn't happy for some reason or other. Didn't know just what to say, but knew something was due, so he told the draftsman not to get impertinent, but to give the new system a chance. They'd get it straightened out in due time.

"Nothing doing, Mr. Johnson. I've had a good job and I've enjoyed working for you. But instruments are my specialty and I've spent a lot of time studying 'em. I don't propose to switch off on washing machines, and I'm not keen on spending half my time trying to make a fool system "function." Guess that's the right word; it's what Mr. Foolem uses all the time.

"I'm getting through on the first and I'm hoping to tie up with someone who thinks more of getting out product than in making a cut-and-dried system fit every business. I hope you've made a bunch of money the last couple of years, because you'll need it before the system gets through with you. You always were tenderhearted and I suppose you felt that the poor suckers had to make a living somehow."

Johnson would have been happier if I'd been somewhere else, but he had to make the best of it of course. So to get me away from the wail of the draftsman he took me over to the new shop where he'd been making some new meters on a Government order. He knew things had been going well here and he wanted me to see a real live department. But the blight had struck while he was away and he was doomed to disappointment here also.

He had put a young chap in charge who labored under the idea that the main idea in running a shop was to get out product rather than to bolster up a weak-kneed, if elaborate, system. He had worked hard; had laid out the whole plant; had nearly 500 people at work and only had a small office force with 11 people all told on the nonproductive list.

He had a live little organization with every man on his job, with an apology for a system which managed to keep track of supplies, production and shipping so effectively that they had got out something over a thousand meters a day, much to the Government's surprise and gratification.

Johnson didn't know that the germ of the F. & G. outfit had flown over to the new plant and there was a surprise in store for him.

This shop with its small office force didn't fit into the great and only system of F. & G., and quite forgetting that this was the only department which was

really earning a real live dividend, they ripped it up the back and installed the system. This I suppose is on the basis of "what's a dividend anyhow among friends as compared with a real 18-carat system."

Things were not going well at all. Part of the plant was idle for want of stock. The system was there all right, but the stock clerk told Johnson that it took the requisitions so long to break its way through all the channels of red tape that the stock ran out before the purchasing agent had asked for a quotation.

"Never happened before, Mr. Johnson. Before they

busted up our plan of ordering material we had it ready every time."

Johnson found some other changes also, none of which seemed to be just to his liking. The office space had been enlarged to three times its former size. In place of 11 people there were now 36, a number of them high-priced individuals who never let a little thing like production stand in the way of operating a 12-cylinder system.

But while the office force had gone up the production board showed the opposite tendency as to the number of meters shipped per day. Johnson could hardly believe his eyes, but the figures were there. Instead of 1000 meters a day the highest output for the week was under 600 a day, and there seemed to be no improvement in sight—system or no system.

As a matter of fact there was another factor of which the new men with a skin full of system never knew existed. This was the human factor—the most important in the shop. Instrument makers are a temperamental lot as a rule, who will work their head off for a foreman they like or sulk like children when the boss rubs 'em the wrong way. And as the average systematizer knows about as much about human nature as a cat does about corn plasters, the F. & G. outfit

left this factor entirely out of the equation. In the meantime Johnson is paying the bill and wondering how he can save his face and his cash at the same time.

System is a great thing in any business. But you've got to have a few grains of horse sense to know human nature and appreciate its value, and to know when and where to use forms and furbelows and when to dispense with them. The systematizer who does not consider this in the future is going to have hard sledding.

Indispensability

BY R. BLONDIN

In looking over a magazine the other day the advertisement of a correspondence school caught my attention on account of its "scare-head" introduction, "Are you an indispensable man?" and it brought to my mind examples of men who believed that they were "fire-proof."

There was Andrew, the production clerk in our shop, who could tell you right off the bat that pattern A-342 was the base bracket for the electric motor on our No. 3 machine and that if Jones' foundry lived up to its promise made when our requisition 41,144 was sent on January 'steenth, we would receive six castings next week to apply on our work order No. M-etc.

That is just a sample of the way Andy carried records in his head. He surely missed his vocation; he should have been a chess player who blindfolded could take on a dozen opponents at a clip.

Whenever anybody wanted to know what was going on in the shop Andy supplied the information "straight from the bean." Now beans are excellent storehouses for information, but when a man keeps it all to himself he might as well take all of the firm's records with him when he goes home at night. Or if he takes a notion to end his sorrows by plunging into the river he might weight his neck with a few ledgers and card files instead of the proverbial millstone.

Eventually Andy developed a "swelled head," became careless, and at last went in to tell the boss how good he (Andy) was and that if his salary was not increased 50 per cent. or so the company would be minus an indispensable man. Furthermore it was a surprise that his efforts and genius had not been recognized. He was the only man who knew how to find patterns; he was the only person who could give delivery dates and other vital information.

When he was all through airing his grievances and boosting his own stock the boss cut loose and told Andy a few things that he either did not know or did not want to know.

"Young man, do you realize that indispensability does not mean making a secret of your work so that when you are away two weeks, as you were, work is at a standstill simply because you have not been ingenious enough to devise some records for the guidances of those who must carry on your work during your absence? Do you realize that with all your knowledge of what is going on your estimates of production are weeks away from the mark?

"You may be a memory wizard, but even good memories cannot be trusted all the time. You know little about the work you are handling and are trying to cash in on your ability to remember facts. If you had a real desire to be a valuable man you would of your own initiative have kept some sort of record of your activities; you would have devised some scheme by which you could predict deliveries by some method more rational than mere guesswork.

"Please don't forget that your guessing wrong cost us the Armstrong contract and another slip of your prodigious memory caused us to order 40 more of those heavy press frames than we will be able to use in the next two years.

"Now you come to me and call yourself indispensable! You are on a par with the workman who 'soldiers' on a job to make it last. Also you are extremely dispensable and I've made arrangements to have you replaced by a young man who does not rely on his memory but puts things on paper, and when he has systematized the production job so that a clerk can handle the work I've got other work for him."

That was the end of Andy. I admit that for a few weeks we had a tough time of it without the "memory hound," but then, Napoleon lost his job too, and France is bigger and better than ever. *Sic transit gloria mundi!*—which means in plain United States, "Everybody gets his and the world lives happily ever after."

LATEST DEVELOPMENTS IN THE AUTOMOTIVE INDUSTRIES

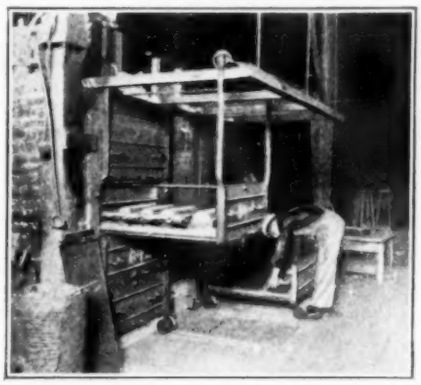
Aircraft · Motor Trucks · Tractors

In 1918 31,512 motor trucks were registered in New York City against 25,078 in 1917, representing a gain of 6434 for 1918. During the same period New York State increased its trucks from 55,402 to 75,268, a year's gain of 19,866, representing 34 per cent. State Secretary Hugo estimates the number of motor trucks which will be registered in the state during 1919 at 115,000, which means an increase of approximately 40,000 trucks.

The Bureau of Standards in Circular 78 shows the result of tests of the use, serviceability, method of application and composition of solders for aluminum. It was found that all soldered joints are subject to rapid corrosion and disintegration and are not recommended except where protection from corrosion is provided. Suitable compositions for solders are obtained by the use of tin, with addition of zinc or both zinc and aluminum within wide limits.

The noninflammable balloon gas, helium, having 92 per cent. of the buoyant effect of hydrogen, is produced on a commercial scale at the Linde and Claude plants at North Fort Worth, Tex., and at the Jefferies-Norton plants at Petrolia, Tex. These plants are operated with a natural gas containing 0.9 per cent. helium by volume, and which is supplied by the Lone Star Gas Co. through a pipe line from the wells at Petrolia, about 100 miles northeast of Fort Worth, for domestic and industrial consumption. The Linde plant produced the first helium on Mar. 1, 1918, and by September had increased its yield to 7750 cu.ft. per day, of 67 per cent. purity, which was later repurified to about 92 per cent. At the time of signing the armistice the first shipment of 147,000 cu.ft. of 93 per cent. helium was on the dock about to be loaded aboard ship.

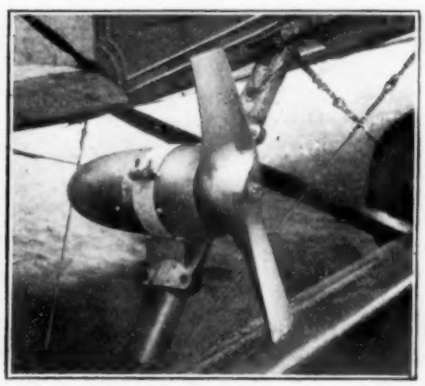
The annealing of the Hall-Scott airplane-motor cylinders to obtain a uniform hardness of about 30 points on the scleroscope is performed in specially constructed ovens for this purpose, as shown in the illustration. After the cylinders are placed in the ovens the fire is started and the ovens are brought to a temperature of approximately 1500° F. This process requires about five hours. The ovens are then allowed to cool to a temperature of about 200° F., after which the cylinders are taken out. The Hall-Scott airplane-motor cylinders, having an average metal thickness of $\frac{1}{4}$ in., are castings weighing 25 lb. each, yet they develop 30 hp. per cylinder. The water jackets, which are cast integral, are only $\frac{3}{32}$ in. thick.



In the application of wireless telephony to the use of airplanes the development of insulating materials to exclude the noise of the engine and the air was one of the most difficult problems to be solved. The illustrations show the airmen equipped with a Western Electric Co. radio telephone transmitter and receiver as it is used. The wind-driven generator supplies electrical energy to the vacuum tubes.

The Motor Truck Club of New Jersey announces that no changes will be asked from the present Legislature for the motor-truck law of that state. There are several features of the present law which are particularly desirable. The examination for drivers' license comprises a written and a road test. The provisions setting the maximum weight of load and truck at 30,000 lb. are such as meet all practical requirements. This makes ample provision for the operation of a 7½-ton truck loaded to capacity.

Joseph E. Pogue spoke before the members of S. A. E. about engine fuel substitutes as follows: "There are three substitute engine fuels in sight—benzol, alcohol and shale-oil distillate. Benzol is now ready to compete with gasoline in a small way; alcohol and shale-oil distillate will be ready to compete only on a higher level of prices. As to the resources of each, benzol is a by-product of coal and the quantity produced depends upon the coal subjected to by-product recovery; benzol will be manufactured in constantly increasing quantity, but the total supply can never fill more than a small part of the engine-fuel requirement. Alcohol and shale-oil distillate on the contrary are main products made from raw materials of almost unlimited availability. They may be produced to fill any need however great if we are willing to pay the price. Whether shale-oil distillate or alcohol will eventually become the more important engine fuel cannot be foreseen. But since shale oil is similar to crude petroleum and can be made to yield an analogous range of products a shale-oil industry is certain to supplement and eventually to succeed the petroleum industry and hence shale-oil distillate is bound to become a prominent motor fuel."



Sparks from the

Forty Thousand Tractors Needed in France

Only 3033 Tractors in France and More Than 8,000,000 Acres to Be Cultivated Mechanically

France can absorb 40,000 agricultural tractors during the next four or five years, according to an estimate made by Representative Compère-Morel of the Agricultural Commission. This estimate, which appears to be a very moderate one, is based as follows:

In the period immediately preceding the war, France had 44,500,000 acres of land under cultivation for grain, potatoes and beets. It is estimated that about one-fifth, or 8,600,000 acres, will be cultivated by mechanical means within a very short time. These 8,600,000 acres will have to be plowed in 100 days, on an average; but two-thirds of this land, which is made use of for autumn sowing, will have to be plowed in a period of about sixty days. This gives, therefore, 5,900,000 acres of land to be worked in sixty days, or 98,000 acres per day. It is estimated that a tractor will plow 2½ acres per day. This is probably a rather liberal estimate. On this basis, therefore, 40,000 tractors are required.

A short time ago, figures were issued showing that France possesses only about 800 agricultural tractors. These figures were incomplete. The total number of tractors in service at the end of December, 1918, was 3033, composed as follows: 1835 belonging to French farmers, 898 belonging to the government and loaned to farmers on special terms, 300 tractors in government's reserve. Of the 898 practically all were of American origin, for only forty-seven had been bought from French manufacturers, as follows: Filtz, 20; Doizy, 12; De Dion-Bouton, 3; Tourand-Latil, 10, and Julien, 2.

In the opinion of Representative Compère-Morel, the immediate requirements of France will have to be met by gasoline tractors. But the greatest development, he considers, will be with electrically propelled tractors, the electric current being generated either from water power or from windmills. At the present time all tractors are either gasoline or steam driven.

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January Exports Exceeds Previous Months

January exports exceeded in value the total for any previous month in the history of American commerce, according to a statement issued recently by the Bureau of Foreign and Domestic Commerce, Department of Commerce.

The export figure announced for January is $623,000,000 against a total of $566,000,000 for December and $505,000,000 for January of last year. Only twice before have exports reached the $600,000,000 mark. During the seven months of the fiscal year ended with January the exports totaled $3,798,000,000 compared with $3,450,000,000 for the corresponding period of the previous year.

The value of imports into the United States in January was $213,000,000 compared with $211,000,000 in December and $234,000,000 in January, 1918. For the seven months ended with January imports totaled $1,698,000,000, which is a slight gain over the $1,634,000,000 for the similar period of the previous year.

The excess of exports over imports in January was $410,000,000, an impressive total when it is remembered that the excess of exports for the entire fiscal year 1914, the last normal year, was only $470,000,000.

Imports of gold amounted to $14,000,000 for the seven months ended with January against $79,000,000 last year. Exports totaled $23,000,000 for the same period compared with $173,000,000 in 1918.

Imports of silver amounted to $41,000,000 for the seven months, or practically the same as for the previous year. Exports amounted to $179,000,000 against $52,000,000 for the corresponding seven months of the fiscal year 1918.

Swedish Market for American Products

Sweden offers to American exporters a market for a variety of products, including automobiles; asbestos; motor plows; trucks; inner tubes, and tractor tires; brass; belting of all materials; bicycle accessories; benzine casks; all kinds of chemicals; copper sheets and tubes; cutlery of all kinds; all kinds of clocks; electrical appliances, batteries, motors, and wires; glass industry materials; glasses for boilers; hardware; iron tubes, sheets, wire, and pig; leather; accessories for looms; machinery and tools; all kinds of oil, both for use in the varnish industry and for lubricating; paint and paint-industry materials; paper-making machines; petroleum; rubber goods; hydraulic presses; steel; tin plates; tools; typewriters; woodworking machinery; watches. It is requested that catalogs in quadruplicate be sent to Consul Wallace J. Young, Goteborg, Sweden.

Personals

FRANK D. JENKS, formerly with the New England Westinghouse Co., Chicopee Falls, Mass., is now with the Bardons & Oliver Co., Cleveland.

LEON HART, recently with the New England Westinghouse Co., Chicopee Falls, Mass., is now engaged in consulting work in Hartford, Conn.

ALBERT V. BROUILLETTE, formerly with the New England Westinghouse Co., Chicopee Falls, Mass., is now engaged in efficiency work as a consulting engineer.

R. W. HERRICK, formerly with the Ford Motor Car Co., Detroit, Mich., has taken a position as efficiency engineer with the Hart-Parr Co., Charles City, Iowa.

FLOYD G. HODSON of Clarksville, Iowa, has returned from France where he has been the representative of the International Harvester Co. for the past two years

FRANK RAYBOULD, formerly with the New England Westinghouse Co., Chicopee Falls, Mass., is now with the Westinghouse Electric and Manufacturing Co., East Pittsburgh, Penn.

CHARLES W. MOON, formerly director of personnel of the R. K. LeBlond Machine Tool Co., Cincinnati, Ohio, has taken a similar position with the Timken Roller Bearing Co., Canton, Ohio.

J. B. CHILDE, formerly of the Cleveland-Canton Spring Co. and the Cleveland Axle Co., is now the general manager of the Canton Spring and Forge Plants, Standards Parts Co., Cleveland, Ohio.

CHARLES N. THORN, of the Intercontinental Machinery Corp., New York, will sail for England in the near future. He expects to make arrangements for an active representation of his company in Europe.

IRA C. WILLHITE has been appointed manager of the Hart-Parr Company's branch house at Wichita, Kansas. Mr. Willhite's position in the sales department of the home office will be taken by A. A. TEAL of Davenport, Iowa.

H. Y. SMITH, formerly vice president of the Kern-Hunter Co., Milwaukee, Wis., is now engaged under his own name in the handling of contractors' and industrial plant equipment at 1227 First National Bank Building, Milwaukee, Wis.

E. S. DAVIS has returned to the Tate-Jones Co. after six months of service as Chief of the Fuel Oil Section of the Bureau of Oil Conservation, United States Fuel Administration. He will be district manager and director of sales and service in the Chicago district, with offices at 931 Monadnock Building, Chicago.

World's Industrial Forge

By E.C.Porter, News Editor

Exporting Furnace Equipment to Mexico

The Electric Furnace Co., Alliance, Ohio, is constructing for shipment to Mexico, a complete Baily Electric Furnace equipment for melting brass. The furnaces are of the tilting type, and are rated at 105 kw. electrical capacity, 1500 lb. hearth capacity, and a melting rate of 600 lb. per hour. The equipment has been purchased by G. Amsinck & Co., N. Y.

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Engineering Council in Annual Meeting Reviews Year's Work

At its second annual meeting in New York Feb. 20 the Engineering Council voted to appoint a small committee to advise and confer with the Reconstruction Commission of the state of New York. This action was taken in response to a request from Abram I. Elkus, chairman of the commission, which request probably resulted from the letter sent by the Engineering Council to Governor Smith. The executive committee reported on the effect of the hearing called by the Engineering Council in regard to the sudden dismissal of 339 Public Service Commission engineers and the fact that reinstatement followed. It was also decided to appoint a special committee to consider the classification and salaries of railway and Government engineer employees.

Among the many committee reports one of the most important was that of the Engineering Societies' Employment Bureau, which up to Feb. 15 had 1400 applications for positions and found positions for 200, and to which the national societies have agreed to give larger appropriations.

The new representatives in the Engineering Council are A. N. Talbot, past president of the American Society of Civil Engineers; J. R. Worcester, consulting civil engineer, of Boston; M. E. Cooley, president of the American Society of Mechanical Engineers, and Albert Ladd Colby of South Bethlehem, Penn., representing the American Society for Testing Materials. The other members whose terms expired were reelected. The total number in the council is now 26.

The new officers are: Vice-chairman, E. S. Jacobus, advisory engineer of Babcock & Wilcox Co.; C. S. Churchill, second vice-chairman, vice president of the Norfolk and Western R.R. The additional members of the executive committee are Comfort A. Adams, president of the American Institute of Electrical Engineers; Philip N. Moore, past president of the American Institute of Mining Engineers; Charles E. Skinner, engineer of the research division, Westinghouse Electric and Manufacturing Co. J. Parke Channing and A. D. Flinn were reëlected chairman and secretary respectively.

Business Items

The Standard Parts Co., Cleveland, Ohio, has moved its executive offices to the Standard Parts Building, 12th St. and Walnut Ave., Cleveland.

The Morse Engineering Co., western representative of the Morse Chain Co., has moved its Kansas City office from R. A. Long Bldg. to Suite 211-212, Finance Building.

Louis G. Henes, San Francisco, Cal., has moved his offices from the Monadnock Building to 75 Fremont St., where he will display a complete line of machine tools and shop equipment.

The Hess Steel Corporation, Baltimore, Md., has established a branch office in the Kresge Bldg., Detroit, Mich. Geo. B. Norcross, who is now representing the Hess Steel Corporation in that district, will be in charge.

The Wellman-Seaver-Morgan Co., at its annual meeting in Cleveland on Feb. 18, reëlected the retiring board of directors. Immediately after the meeting of the stockholders the following officers were elected: Edwin S. Church, president and general manager; S. H. Pitkin, vice president; George W. Burrell, second vice president, and W. H. Cowell, secretary and treasurer.

The American Bronze Corporation, Berwyn, Penn., at its annual meeting held recently elected George D. Porter of Philadelphia president, succeeding John W. Watson, who severs his active connections with the company to devote his time to a new company bearing his name, the details of which will be announced shortly. Mr. Watson, however, remains on the board of directors and continues his financial interest in the business. The active management of the business will continue in the hands of Matthew C. Dittmann as vice president and general manager. Edwin G. Anderson, advertising and sales manager, was elected secretary. Mr. Anderson has been connected with the company for some years past, originally acting as Pacific Coast representative. Charles H. Baker, formerly associated with the Timken Roller Bearing Co., Canton, Ohio, was elected assistant secretary and treasurer, and in addition to these duties will be in charge of production.

France Has Removed Its Import Embargo

Announcement Made by War Trade Board. List Includes Metals and Various Articles Made of Metal

The War Trade Board announces in a new ruling (W. T. B. R. 612), for the information of exporters in the United States, that the French import restrictions have been removed from the following list of commodities:

Metals.—Iron ore; iron scrap; iron filings; copper ore; lead ore; tin ore; zinc ore; nickel ore; native mercury; arsenic and its ore; cadmium, unrefined; bismuth, water glass; ores not above mentioned (except those of chromium, molybdenum, and wolfram).

Manufactures of metal.—Machines for paper manufacture; machines and presses for printing, typography, lithography, phototyphy copper-plate, and for all other forms of printing on paper, cardboard, wood, metal, celluloid, plastic material, in black or in colors, flatwise, in grooves, or in relief; machines for folding, and goffering; machines for coating, polishing, pasting, bronzing, automatic machines, machines and materials for book-binding; ruling machines, perforating machines, envelope-making machines, wood and tubes for trimming, cutting, stamping, lathes for setting and boring stereotype plates; presses and machines for stereotypy, other than hydraulic presses and machines; drying presses, crucibles, and furnaces for stereotypes; presses for casting cylindrical stereotypes; cylinders, laminating machines; linotypes, and other composing machines; machines for rinsing, corking, capping, and filling bottles; machinery and tools for refrigeration; stereotypes, plates, and dies for printing on paper, other than coloring, with or without drawings obtained by photo-mechanical processes or others; sewing needles; sewing machine needles; needles for lace, tulle, and wool trades; modeled and jointed; hooks and awls for embroidery, button hooks; office and store punches for perforating paper and cloth; pins; buckles, clasps, hooks, eyes, and fasteners for garments, suspenders, belts, gloves, shoes, and all other such material of iron, steel, copper, brass, and other common metals in whole or in part; hooks; umbrella mountings; household articles of iron, steel, and black sheets not listed; coffee grinders.

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Steel Treaters' Society Formed

A society known as the American Steel Treaters' Society was recently formed in Chicago the object of which will be to promote the arts and sciences connected with the heat treatment of steel. The society will hold meetings

for the reading and discussion of papers bearing upon processes, instruments, equipment, apparatus, etc., employed in practical and research work connected with the art; collection, publication and dissemination of technical and practical knowledge for the improvement of conditions in connection with the heat treatment of steel; and to closely unite those engaged in the practical and technical branches of same.

This society publishes a monthly journal which brings the papers and discussions at various meetings directly to members. Sample copies of the journal and other information may be had by addressing the general office of the society at 154 East Erie St., Chicago, Ill.

Trade Catalogs

Zelnicker's Bulletin No. 261. Walter A. Zelnicker Supply Co., St. Louis, Mo. Listing a few specials, such as rails, cars and trucks, bridges, pipe, generator sets, car tanks, and used track spikes. The bulletin is free to the trade.

The Universal Electric Tools. The independent Pneumatic Tool Co., Chicago, Ill. Circular. Pp. 4; 9 x 12 in. It gives a brief description of Thor portable electric drills and grinding machines and illustrates the various models.

Handbook on Die Castings. Precision Castings Co., Syracuse, N. Y. Catalog. Pp. 95; 6 x 9 in. A useful handbook giving complete information about dies and casting processes, metals, methods of fabrication, finishing, etc., with useful tables. It is profusely illustrated.

Price List. Chas. A. Schieren Co., 3038 Ferry St., New York. Booklet. Pp. 12; 6 x 9 in. This new price list differentiates the various kinds of Schieren beltings not only by name and markings but also by grades and weights. Detailed specifications and illustrations are given.

The Story of Schieren Beltings. Chas. A. Schieren Co., 30-38 Ferry St., New York. Catalog. Pp. 38; 7¾ x 5¼ in. This is really a textbook on the leather-belting business. It describes and illustrates every step of the process of manufacture from the selecting of the hides to the shipping of the finished product.

Selectometer. Smith Serrell Co., Inc., New York. This is a chart in the form of a dial that determines the correct size of Francke flexible couplings for any given drive. The instructions are on the back of a card. The Selectometer may be had by writing to the Smith Serrell Co., 90 West St., New York.

New Publications

George Westinghouse: His Life and Achievements.—By Francis E. Leupp. Three hundred 6 x 9 in. pages; illustrated; bound in cloth. Published by Little, Brown & Co., Boston. Price, $3.

Mr. Leupp's story of one of America's great inventors and engineers is interesting and readable. He touches on Westinghouse's boyhood, his experience in the Civil War, his three months' trial of Union College and then proceeds to narrate his career as inventor and manufacturer. A car replacer, suggested by a tedious wait due to a train wreck, was his first commercial venture. His successes with the air brake, lighting the Columbian Exposition, elevated-railway electrification and Niagara power are all described. An idea is given of the magnitude of Westinghouse's manufacturing operations and his control of them up to the receivership of the Westinghouse Electric and Manufacturing Co. in 1907. The personal relationships of Westinghouse are sketched but briefly.

The book is addressed to the non-technical reader, but its engineering detail is sufficient for most engineers who are not specialists.

Obituary

M. THOMAS O'LEARY, president and treasurer of the L. W. Pond Machine and Foundry Co., Worcester, Mass., died at his home in Worcester, Mass., on Feb. 22, 1919. Mr. O'Leary was born in Millbury 42 years ago, but had been a resident of Worcester the greater part of his life. After the completion of his studies, he entered the employ of the L. W. Pond Machine and Foundry Co. and advanced to the position of general manager and treasurer. Four years ago he purchased the control of the company and became the president and treasurer. He was a director of the Merchants National Bank and a trustee of the Bay State Savings Bank. He was a member of the American Foundrymen's Association, the New England Foundrymen's Association, the Washington Club and Alhambra Council, Knights of Columbus.

Export Opportunities

George Komorowski, an engineer now at Ugine, Savoie, France, would like to correspond with American makers of machinery, factory supplies, and hardware for shipment to Poland under an exclusive sales agency agreement.

The Factory Products Corporation, 2 Rector St., New York, has formed an association with the Engineers' Corporation, a subsidiary of the J. G. White Engineering Corporation, for the special purpose of exporting American machinery, hardware, engineering supplies and building material. The Factory Products Corporation is a consolidation of the Factory Products Export Corporation, organized in 1914 to make shipments to the Allies, and of the Manufacturers' Agents Co., Inc., organized in 1916 to develop American trade in South America. The trade connections of the consolidated corporation extend to Argentina, Chile, Ecuador, Venezuela, Mexico, the British West Indies, China, India, the Philippines, the Straits Settlement and the Dutch East Indies. It has ten resident agencies established in the Far East. The officers are Walter W. Vick, president; Frank Smith, Earl Harding, vice presidents, and D. M. Barclay, secretary and treasurer.

The Bureau of Foreign and Domestic Commerce, Department of Commerce, Washington, D. C., has inquiries for the agencies of machinery and machine tools. Any information desired regarding these opportunities can be secured from the above address by referring to the number following each item:

A man in Norway desires to purchase or secure an agency for the sale of drugs, chemicals, colors, dyestuffs, paints, iron and steel, metals, heavy hardware, general hardware, specialties generally included in hardware stocks, and steel, copper wire and cable. Correspondence may be in English Reference. No. 28297.

A man in France wishes to secure an agency for the sale of tools, machine tools, metal saws, lubricating apparatus, faucets, ball bearings, and belts. Correspondence should be in French. Reference. No. 28571.

An agency is desired by a man in France for the sale of machine tools, tools, steel, steel plates, chains, nails, bolts, screws, etc. Correspondence should be in French. No 28577.

A man in France desires to secure an agency for the sale of machine tools and crowbars. Correspondence should be in French. References. No. 28581.

A man in Norway desires to purchase iron and steel, metals, heavy hardware, machinery, electrical apparatus and supplies; light, heat, and power service, lead and steel and copper wire and cable. Terms, cash against documents at destination. Correspondenne may be in English. Reference. No. 28305.

An agency is desired, by a man in France, for the sale of metals, hardware, tractors, and raw cotton. Correspondence should be in French. He is willing to come to America for personal consultation with firms References. No. 28535.

Forthcoming Meetings

American Association of Engineers. Annual meeting has been scheduled for May 13 at Chicago.

American Society of Mechanical Engineers. Spring meeting to be held at Hotel Statler, Detroit, Mich., June 16-19, 1919. Secretary, Calvin Rice, 29 West 39th St., New York City.

Boston Branch National Metal Trades Assoniation. Monthly meeting on first Wednesday of each month. Young's Hotel. Donald H. C. Tullock, Jr., secretary. Room 41, 166 Devonshire St., Boston, Mass.

Engineers' Club of Philadelphia will hold its regular meeting at Witherspoon Hall, Tuesday evening, Mar. 18, 1919. Announcement has been made of a special meeting on Apr. 23, at which Arthur J. Baldwin, vice president of the McGraw-Hill Co., Inc., will speak.

Engineers' Society of Western Pennsylvania. Monthly meeting, third Tuesday; section meeting, first Tuesday. Elmer K Hiles, secretary, Oliver Building, Pittsburgh, Penn.

Manufacturers' Aircraft Association, Inc. Annual aeronautical exposition to be held in New York, Mar. 1 to 15.

National Foreign Trade Council. Annual meeting at Chicago, April 24-26.

National Metal Trades' Association will hold its 21st annual convention at the Hotel Astor, New York, Apr. 23 and 24.

New England Foundrymen's Association. Regular meeting, second Wednesday of each month. Exchange Club, Boston, Mass. Fred F. Stockwell, 205 Broadway, Cambridgeport, Mass.

Philadelphia Foundrymen's Association. Meeting first Wednesday of each month. Manufacturers' Club, Philadelphia, Penn., Howard Evans, secretary, Pier 45, North Philadelphia, Penn.

Providence Engineering Society. Monthly meeting fourth Wednesday of each month. A. E. Thornley, corresponding secretary, P. O. Box 796. Providence, R. I.

Rochester Society of Technical Draftsmen. Monthly meeting, last Thursday. O. L. Angevine, Jr., secretary, 857 Genesee St., Rochester, N. Y.

Superintendents' and Foremen's Club of Cleveland. Monthly meeting, third Saturday. Philip Frankel, secretary, 310 New England Building, Cleveland, Ohio.

Technical League of America. Regular meeting, second Friday of each month Oscar S. Teale, secretary, 240 Broadway New York.

United States Chamber of Commerce Annual convention to be held at St. Louis Apr. 28-May 3.

Western Society of Engineers, Chicago Ill. Regular meetings, first, second, third and fourth Mondays of each month, except July and August. Edgar S. Nethercut, secretary, 1735 Monadnock Block, Chicago, Ill